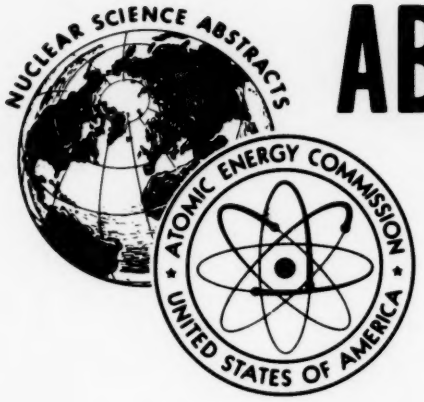
NUCLEAR SCIENCE ABSTRACTS



Volume 26 Number 19

Abstracts 45181-47652

October 15, 1972

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Volume 26, Number 19, October 15, 1972

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NEWLAND, E. A., Radiation treatment of sewage, 25:140 (AAEC/LIB/Bib-254)

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The subject index consisting of specific materials, objects, and processes is arranged alphabetically. Modifying phrases specific to these subjects in turn are arranged alphabetically under the subjects.

TRANSURANIUM ELEMENTS
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separation by ion exchange and complex-formation elution, 25:251(P)

TRIETHYLENETETRAMINE
complexes with cobalt(III) and rhodium(III) chlorides, radiation effects on labeled, thermal-neutron, 25:137
TRITIUM
content in Cattaraugus Creek near West Valley Processing Plant, July through Dec. 1969, 25:258 (DOCKET-50201-48)
content in Cattaraugus Creek near West Valley Processing Plant, Jan. to July 1970, 25:259 (DOCKET-50201-49)
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372 (UCRL-72739) CONSTRUCTION OF A UNIQUE UNDERGROUND WHOLE BODY COUNTER. Griffith, R. V.; Anderson, A. L.; Lindeken, C. L. **(California Univ., Livermore. Lawrence Radiation Lab.).** Oct 1970. 27p. (CONF-701009–1). Dep. NTIS.

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Volume 26, Number 19 October 15, 1972

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical Chemistry

Refer also to abstracts: 45286, 45310, 45405, and 45681.

45181 (CISE-R-172) REACTOR CHEMISTRY: ANALYTICAL WORK. Topical Report No. 6. Cerral, E.; Triulzi, C.; Trucco, R. (Centro Informazioni Studi Esperienze, Milan (Italy)). Apr 1967. 116p. Dep. NTIS (U. S. Sales Only).

Analytical methods applied to determinations of materials of interest in the field of the CIRENE program are described. Chemical procedures are given for determination of Al, B, Cl, Cr, Co, Cu, Pb, Lu, Mo, Nb, phosphate, sulfate, Th, Sn, Ti, U, and V. Emission spectroscopic methods are discussed for analysis of solutions, stainless steel, and zircaloy. Radiochemical procedures, including preparation of γ standard sources and methods for uranium determination in loop samples, are described. An appendix of miscellaneous applications is included. (M.C.G.)

45182 (JAERI-M-4594) CHEMICAL ANALYSIS PROCEDURES FOR JMTR. Tone, Hirohito; Yamamoto, Katumune; Okagawa, Seigo; Yokouchi, Iichiro; Atomura, Masakatu (Japan Atomic Energy Research Inst., Tokyo). Sep 1971. 211p. (In Japanese). NTIS (U. S. Sales Only).

Chemical analyses at the JMTR are important for the operation of reactor and high-pressure water loops and for the reactor and loop chemistry. The analytical procedures and equipment employed are described. Many of these procedures have been standardized to speed up analytical services in the laboratory. The objects for chemical analyses are active and nonactive nuclides and chemical compounds in the primary coolants, which are concerned with corrosion, fuel failure, plant safety, water treatment in loops and reactor, and water chemistry. (auth) (Japan)

45183 (TID-7029(2nd Ed.)) SELECTED MEASUREMENT METHODS FOR PLUTONIUM AND URANIUM IN THE NUCLEAR FUEL CYCLE. Second Edition. Rodden, Clement J. (ed.) (Office of Information Services (AEC), Washington, D. C.). 1972. 440p. Dep. NTIS.

Separate abstracts were prepared for Part I, General Considerations, and for each of the 4 sections of Part II, Analytical Methods. The sections are: uranium-bearing materials, plutonium-bearing materials, hot process solutions, and apparatus and reagents. (M.C.G.)

For abstracts of individual sections see: 45184–45186, 45190, and 45191.

45184 (TID-7029(2nd Ed.), pp 3-65) GENERAL CONSIDERATIONS. 1972.

In Selected measurement methods for plutonium and uranium in the nuclear fuel cycle.

Standard reference materials, sampling, and bulk measurements are discussed for determination of Pu and U in nuclear materials. (M.C.G.)

45185 (TID-7029(2nd Ed.), pp 69-252) URANIUM-BEARING MATERIAL. 1,000 Series. 1972.

In Selected measurement methods for plutonium and uranium in the nuclear fuel cycle.

Methods are considered for determination of the uranium concentration and its isotopic composition in product material. Thirty-five methods are described. (M.C.G.)

45186 (TID-7029(2nd Ed.), pp 253-329) PLUTONIUM-BEARING MATERIAL. 2,000 Series. 1972.

In Selected measurement methods for plutonium and uranium in the nuclear fuel cycle.

Methods are considered for determination of plutonium and its isotopic composition in fuel cycle product material. Sixteen methods are described. (M.C.G.)

45187 MODERN ANALYTICAL TECHNIQUES FOR METALS AND ALLOYS. PART 2. Bunshah, R. F. (ed.). Techniques of Metals Research. Volume III. New York; John Wiley and Sons, Inc. (1970). 520p.

Separate abstracts were prepared for each of 10 chapters. (M.C.G.)

For abstracts of individual chapters see: 45208–45212, 45246–45249, and 45271.

45188 MASKING AND DEMASKING OF CHEMICAL REACTIONS. THEORETICAL ASPECTS AND PRACTICAL APPLICATIONS. Perrin, D. D. Chemical Analysis, A Series of Monographs on Analytical Chemistry and Its Applications. Volume 33. New York; John Wiley and Sons, Inc. (1970). 222p.

The use of masking and demasking of chemical reactions in analytical chemistry, industry, biology, and medicine is discussed. Applications to analytical chemistry are described for titrimetry, precipitation reactions, spectrophotometry, ion exchange, and masking of chemical reactivity. Masking agents for cations are listed. Anions and neutral molecules are classified by types and by species that are masked. The industrial applications are concerned with the control of undesirable effects due to traces of metal ions, including hardness of water, production of blotches or staining and the development of off-flavors and rancidity. Biological and medical applications comprise such examples as metal-ion buffers and treatments for metal poisoning. (D.H.M.)

Activation and Nuclear Reaction Procedures

Refer also to abstracts: 45309, 45567, 45788, and 46146.

45189 (BFL-1/1972) DEVELOPMENT OF METHODS FOR THE APPLICATION OF NEUTRON ACTIVATION ANALYSIS TO THE DETERMINATION OF TRACE ELEMENTS IN FOODS. Progress Report, October 1–December 31, 1971. Toeroek, G.; Schelenz, R.; Fischer, E. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe (West Germany)). Feb 1972. 23p. (In German). Dep. NTIS (U. S. Sales Only).

The significance of trace element determination in foodstuffs is pointed out and the advantages of using neutron activation analysis for such determinations are described. Arguments are presented for a comprehensive analytical scheme. It consists of a combination of radiochemical separations and gamma spectrometry. First results of the testing of individual steps in this scheme are presented. (auth)

45190 (TID-7029(2nd Ed.), pp 331-411) HOT PROCESS SOLUTIONS. 3,000 Series. 1972.

In Selected measurement methods for plutonium and uranium in the nuclear fuel cycle.

The analysis of process solutions of spent fuels for uranium and plutonium is considered and 12 methods are described. Determinations of U and Pu in waste materials are also discussed. (M.C.G.)

45191 (TID-7029(2nd Ed.), pp 413-33) APPARATUS AND REAGENTS. 4,000 Series. 1972.

In Selected measurement methods for plutonium and uranium in the nuclear fuel cycle.

Thirteen pieces of equipment and 33 reagents for use in determination of plutonium and uranium are considered. (M.C.G.)

45192 (TID-25954, pp 373-5) STABLE CESIUM ANALYSIS BY NEUTRON ACTIVATION OF PLANTS FROM THE NEVADA TEST SITE. 1972.

In Radioecology and ecophysiology of desert plants at the Nevada Test Site.

Cesium contents of leaves for several species of plants were determined by neutron activation. Concentrations varied from 30 to 372 nanograms per gram dry weight. (M.C.G.)

45193 (TID-25954, pp 376-8) CYCLING OF STABLE CESIUM IN A DESERT ECOSYSTEM. 1972.

In Radioecology and ecophysiology of desert plants at the Nevada Test Site.

Cesium was determined in plant, animal, and soil samples by neutron activation. Potassium was determined by counting ^{40}K by γ spectrometry. Samples were obtained from the Rock Valley area of the Nevada Test Site in 1969 and 1970. (M.C.G.)

45194 RADIOANALYTICAL INVESTIGATION ON THE EXTRACTION BEHAVIOR OF RHODIUM IN THE THIOCYANATE-TBP SYSTEM. Di Casa, M.; Stella, R. (Univ., Pavia, Italy). Radiochem. Radioanal. Lett.; 10: No. 6, 331-7(15 Jul 1972).

A detailed study of various conditions affecting the extraction of small amounts of rhodium into tributyl phosphate from thiocyanate solutions is reported. Neutron activation analysis was used to measure the extraction efficiencies, thus avoiding the use of spectrophotometric or similar relatively cumbersome methods usually applied. (auth)

45195 DETERMINATION OF ASH CONTENT OF COAL BY NEUTRON ACTIVATION ANALYSIS. Loska, L.; Gorski, L. (Inst. of Nuclear Techniques, Krakow). Radiochem. Radioanal. Lett.; 10: No. 6, 315-22(15 Jul 1972).

A method is presented for determining the ash content of coal by 14-MeV neutron activation analysis using a neutron generator. The activation of silicon and aluminum was the basis of the analysis. The total ash content of coal was determined based on the correlation between the chemical composition of the ash (especially Si and Al content) and the ash content of the coal. The presented method allows the determination of the ash content of coal with a mean absolute error of about 1.8%. (auth)

45196 DETERMINATION OF CHROMIUM IN MILK POWDER. Das, H. A.; Erlich, Y.; Hoede, D.; Zonderhuis, J. (Reactor Centrum Netherland, Petten). Radiochem. Radioanal. Lett.; 10: No. 6, 361-6(15 Jul 1972).

Milk powder sample is irradiated by thermal neutrons for 24 hours and allowed to cool for 10 days. After dissolution K_2CrO_4 is added as carrier and the chromium is extracted as peroxychromic acid into ethyl acetate, then back extracted into the aqueous phase. Chromate is precipitated as $BaCrO_4$ and its activity measured. The time required for an analysis is about 30 minutes. (auth)

45197 NEW METHOD FOR POTASSIUM DETERMINATION BY NEUTRON ACTIVATION IN MINERAL AND ROCK SAMPLES. Soriou, M.; Popescu, G. (Institutul de Fizica Atomica, Bucharest). Ann. Soc. Geol. Belg.; 94: No. 2, 132(1971). (CONF-710953-4).

From European conference of geochronology; Brussels, Belgium (6 Sep 1971).

For potassium determination by neutron activation, the reaction $^{39}K(n, p)^{39}Ar$ is used. Depending on their potassium content, samples of 100 or 200 milligrams are irradiated 40 hours at a flux of 5.10^{12} fast neutrons and 10^{13} thermal neutrons/cm^2 sec. By comparing the potassium contents determined by classical and by neutron activation methods on 12 different mineral samples, the conclusion can be drawn that the precision and the accuracy of the new method are better than ±3%. (auth)

45198 ACTIVATION ANALYSIS OF ENVIRONMENTAL POLLUTANTS. Chattopadhyay, A.; Bennett, L. G. I.; Jervis, R. E. (Univ. of Toronto). Can. J. Chem. Eng.; 50: No. 2, 189-93(Apr 1972).

Activation analysis is a highly sensitive and specific technique for the detection of trace heavy metal pollutants in environmental materials. Comparison of natural "baseline" levels with elevated levels provides direct evidence of contamination. Neutron activation analysis (NAA) was used to determine arsenic, zinc, cadmium, and mercury. Photo-nuclear activation analysis (PNAA) was used to determine lead in soils. Holland Marsh, a market-gardening area north of Toronto, was studied as various herbicides and fungicides were used there. The analyses of soil and vegetation samples, and of human head hair collected from residents are reported. (auth)

45199 ACTIVATION ANALYSIS WITH A Pu–Be NEUTRON SOURCE. Pawaskar, P. B.; Reddy, G. R.; Sankar Das, M. (Bhabha Atomic Research Centre, Trombay, India). Indian J. Technol.; 10: No. 2, 80-2(1972).

Simple procedures are described for the routine activation analysis of manganese in steels and fluorine in fluorites and plant products using a 5 curie Pu–Be neutron source. Manganese analysis is based on $^{55}Mn(n, \gamma)^{56}Mn$ reaction using thermal neutrons from the source and counting the 0.84-MeV photopeak of ^{56}Mn. Fluorine is estimated by $^{19}F(n, \alpha)^{16}N$ reaction using fast neutrons from the source and counting the 6-7-MeV gamma rays of ^{16}N. The results obtained by the methods described are compared with those obtained by chemical methods. (Indian Sci. Abstr.)

45200 GOLD ASSAY ON GEOLOGICAL SAMPLES BY NEUTRON ACTIVATION WITH PRELIMINARY CRUCIBLE FUSION. Leipunskaya, D. I.; Savosin, S. I.; Drynkin, V. I.; (and others). Ind. Lab. (USSR) (Engl. Transl.); 37: No. 12, 1894-6(Dec 1971).

Translated from Zavod. Lab.; 37: No. 12, 1471-3(Dec 1971).

In crucible melting, gold enters the lead alloy from the ore along with other elements; however, lead and these elements produce very little interference in determination of the gold by neutron activation. The lead alloy is irradiated along with standards and the γ spectra recorded. The limit of detection was found to be 0.01 g/ton. It was found that silver could also be determined by this method. (M.C.G.)

45201 ACTIVATION METHODS OF ANALYSIS. Zmijewska, W. (Inst. of Nuclear Research, Warsaw). Wiad. Chem.; 25: 99-122(1971). (In Polish).

The contemporary techniques of activation analysis are described, particularly thermal and fast neutron activation, photoactivation, charged-particle activation, and techniques based on the measurement of prompt gamma radiation. Examples of application are given. (auth) (NSA of Poland)

45202 SIMPLE AND RAPID PROCEDURE FOR STRONTIUM DETERMINATION IN RAT PLASMA USING NEUTRON ACTIVATION. Maillard, M. J. (CEN de Fontenay-aux-Roses, France); Maziere, B.; Comar, D. Bull. Soc. Chim. Fr.; No. 4, 1679-81 (Apr 1972). (In French).

The determination of strontium in small samples of plasma was effected by destructive activation analysis. The separation of strontium was carried out by double precipitation of oxalates (pH8) followed by filtration through an antimony pentoxide column in order to completely eliminate sodium. A third oxalate precipitation gave a manganese-free sample. A series of measurements, carried out on nine 0.5 ml samples of the same rat plasma, yielded the following data: 78.6 ± 3.8 ng/ml. This method is the most accurate for the low plasma volumes considered. (France)

45203 VANADIUM DETERMINATION IN BIOLOGICAL MATERIALS AT NANOGRAM LEVELS BY A CATALYTIC METHOD. Welch, Ross M.; Allaway, William H. (Plant, Soil, and Nutrition Lab., Ithaca, N. Y. Cornell Univ., Ithaca, N. Y.). Anal. Chem.; 44: No. 9, 1644-7(Aug 1972).

A sensitive and accurate spectrophotometric method for measuring amounts of V as low as 5 ng in biological materials is described. Samples are digested with HNO_3–$HClO_4$ and V is separated from interfering elements by complexing with 8-quinolinol in chloroform at pH 4.0. It is then released from the complex by readjusting the pH to 9.4 with an aqueous NH_4NO_3 buffer. Vanadium is then determined in the aqueous extract by its catalytic effect on the rate of oxidation of gallic acid by acid persulfate. The extraction procedure eliminates all interfering elements except Mo. Mo interfered with V determination when it exceeded 10 μg per sample. Comparisons with a neutron activation method were made. Recoveries of V added to plant samples were between 94 and 98%. Recoveries of radioactive ^{48}V added to standard V solutions and carried through the extraction procedure were between 90 and 100%. (auth)

45204 DETERMINATION OF INORGANIC IMPURITIES IN VINYL CHLORIDE BY ACTIVATION ANALYSIS. Bunus, Florin T.; Murgalescu, Sanda (Inst. of Atomic Physics, Bucharest). Talanta; 19: No. 3, 372-7(Mar 1972).

Trace impurities in vinyl chloride were determined by activation analysis in a reactor thermal neutron flux of 1.2×10^9 n/mm^2/sec. Gamma-spectrometry was used to reveal the presence of arsenic and bromine. The impurities determined were: arsenic $8.0 \pm 0.6 \times 10^{-4}$%, bromine $3.07 \pm 0.2 \times 10^{-3}$% and phosphorus $2.0 \pm 0.15 \times 10^{-2}$%. (auth)

45205 PROCEEDINGS OF THE SECOND INTERNATIONAL CLEAN AIR CONGRESS HELD AT WASHINGTON, D. C., DE-

CEMBER 6–11, 1970. Englund, H. M.; Berry, W. T. (eds.). New York; Academic Press, Inc. (1971). 1378p. $85.00. (CONF-701229).

Separate abstracts were prepared for six of the two hundred fifty papers presented. The remaining papers were not in the subject scope of NSA. (D.H.M.)

For abstracts of individual papers see: 45206, 45207, 45244, 45245, 45514, and 45568.

45206 TECHNIQUES FOR SOURCE DETERMINATION IN THE TUCSON BASIN. Post, Roy G.; Wacks, Morton E. (Univ. of Arizona, Tucson). pp 410-18 of Proceedings of the Second International Clean Air Congress. /Englund, H. M. (ed.). New York; Academic Press, Inc. (1971).

From second international clean air congress conference; Washington, D. C. (6 Dec 1970). See CONF-701229.

Two approaches to computer processing of data obtained from elemental analysis of airborne particulate matter by neutron activation were successful. The first program, regression analysis, used less computer time and memory, but the second, least squares, gave a more exact synthesis of the sample spectrum from the library spectra. Compared to other types of analysis, such as spectroscopic, gravimetric, or volumetric analysis, activation analysis is potentially at least an order of magnitude more sensitive for elements with high cross sections. Other advantages of activation analysis are its speed, the fact that it does not damage the sample, and that it is less subject to human error. Its major disadvantage is that activation analysis cannot provide molecular information. However, elemental analysis combined with mineral content information and total organic content should provide sufficient information to relate the particulates to their sources. (auth)

45207 MULTI-ELEMENT ANALYSIS OF AIR POLLUTION PARTICULATES BY NONDESTRUCTIVE NEUTRON ACTIVATION. Dams, Richard (Inst. of Nuclear Research, Ghent); Rahn, Kenneth A.; Robbins, J. A.; Nifong, Gordon D.; Winchester, John W. pp 509-16 of Proceedings of the Second International Clean Air Congress. /Englund, H. M. (ed.). New York; Academic Press, Inc. (1971).

From second international clean air congress conference; Washington, D. C. (6 Dec 1970). See CONF-701229.

Tests of possible applications of neutron activation analysis to the study of trace elements in air pollution particulates indicate that this analytical technique can lead to discovery of unsuspected pollution anomalies such as Cu, meteorologically related time variations that are not the same for all elements, and size distributions that are related to chemical processes of pollution at pollution sources and in the atmosphere. These findings may have immediate usefulness both in pollution monitoring and control and in research on the migration and ultimate removal of pollutants from the atmosphere. (D.H.M.)

45208 ACTIVATION ANALYSIS WITH THERMAL NEUTRONS. Albert, Philippe (CNRS, Vitry-sur-Seine, France). pp 687-754 of Modern Analytical Techniques for Metals and Alloys. Pt. 2. /Bunshah, R. F. (ed.). New York; John Wiley and Sons, Inc. (1970).

Principles of activation analysis, advantages of thermal neutron activation, chemical separations, comparison of radioactivity and check of radiochemical purity, sensitivity, suppression of the risk of contamination, the very high selectivity of the method, examples of systematic analyses, nondestructive methods, and causes of errors of nuclear origin are discussed. (130 references). (M.C.G.)

45209 ACTIVATION ANALYSIS WITH FAST NEUTRONS. Laverlochere, J. (CEN, Grenoble, France). pp 755-75 of Modern Analytical Techniques for Metals and Alloys. Pt. 2. /Bunshah, R. F. (ed.). New York; John Wiley and Sons, Inc. (1970).

The principle and techniques used, the equipment, the advantages and limitations, and the applications of fast neutron activation analysis are considered. (104 references) (M.C.G.)

45210 ACTIVATION ANALYSIS WITH GAMMA RAYS AND CHARGED PARTICLES. Engelmann, Ch. (CEN de Saclay, Gif-sur-Yvette, France). pp 777-865 of Modern Analytical Techniques for Metals and Alloys. Pt. 2. /Bunshah, R. F. (ed.). New York; John Wiley and Sons, Inc. (1970).

Topics covered include: advantages and inconveniences of γ and charged particle activation analysis, principle of determination, choice of nuclear reaction and experimental conditions, standardization of the determination, examples of use, and future perspectives. (126 references) (M.C.G.)

45211 USE OF COMPUTERS IN ACTIVATION ANALYSIS. Laverlochere, J. (CEN, Grenoble, France). pp 867-80 of Modern Analytical Techniques for Metals and Alloys. Pt. 2. /Bunshah, R. F. (ed.). New York; John Wiley and Sons, Inc. (1970).

The use of digital computers in the activation analysis method to facilitate optimization and exploitation of this technique and to improve its performance is discussed. Apparatus and technique, applications, and limits and advantages are considered. (50 references) (M.C.G.)

45212 GENERAL CONCLUSIONS ON THE METHODS OF ACTIVATION ANALYSIS. Albert, Ph. (CECM-CNRS, Vitry-sur-Seine, France). pp 881-4 of Modern Analytical Techniques for Metals and Alloys. Pt. 2. /Bunshah, R. F. (ed.). New York; John Wiley and Sons, Inc. (1970).

Choice of an activation method among those that are candidates for solution of an analytical problem is illustrated by the example of the determination of oxygen. (M.C.G.)

45213 DEVELOPMENT AND APPLICATION OF A SYSTEMATIC APPROACH TO ELEMENTAL ANALYSIS IN FORENSIC INVESTIGATIONS. Whitworth, James Bradley. Austin, Tex.; Univ. of Texas (1971). 235p. University Microfilms Order No. 72-19,693.

Thesis.

A program of cooperation between the Texas Department of Public Safety (DPS) and the Nuclear Reactor Laboratory (NRL) of the University of Texas at Austin was initiated. The purpose of this program is to apply analytical techniques used in the NRL to actual forensic cases in which the DPS provides samples and guidance. The techniques used in these analyses are neutron activation analysis (NAA) and nondispersive x-ray fluorescence (NDXF). Analysis of data is accomplished with two computer programs, one for scintillation detector spectra and one for solid-state detector spectra. Evidence from several actual cases were analyzed. Reactor neutron activation coupled to a Compton-suppressed Ge(Li) detector and versatile computer program for semiautomatic analysis, is used to investigate some actual criminal cases. In addition to establishing lower limits of detectability with typical forensic evidence, trace analyses of some types of evidence heretofore unreported were obtained. The value of using a Compton suppression device for certain types of samples is shown. Limits of detectability for several elements were determined with a 1000 μgm ^{252}Cf neutron source using both Ge(Li) and NaI(Tl) detectors. It was hoped that cyclic activation with ^{252}Cf would add to the information obtained with reactor activation. Preliminary results indicate that the Ge(Li) detector is too inefficient for this work except in very special cases. Nondispersive x-ray fluorescence was used to supplement the neutron activation data of most of the forensic cases attempted. Samples were excited by ^{238}Pu, ^{241}Am, and ^{109}Cd radioisotopic sources and the spectra were acquired on a cooled Si(Li) detector. In several cases the NDXF data substantiated or supplemented results obtained by NAA. The results proved that NDXF is a fast, inexpensive method to analyze forensic samples for ratios of minor elements. In addition to the routine cases, survey projects are in progress on paint chips and metal alloys. These two classes of samples proved to be troublesome for other analytical techniques and this program is establishing the capabilities of NDXF in these areas in anticipation of future cases. (Diss. Abstr. Int., B)

45214 NEUTRON ACTIVATION ANALYSIS OF TRACE ELEMENTS IN HAIR. Huckabee, John W. Laramie, Wyo.; Univ. of Wyoming (1971). 75p. University Microfilms Order No. 72-13,028.

Thesis.

To determine the trace element content of the hair of natural free-ranging mammals, hair samples were collected from several populations in Idaho and Wyoming. To determine the variation in hair trace element content of several sympatric species, small mammals were trapped in an area in Jackson Hole, Wyoming. To determine the uptake by an animal and subsequent deposition in hair of an abundant environmental element, small mammals were trapped for hair analyses in highly mineralized zones in Idaho and Wyoming. Hair analyses were by neutron activation with gamma spectrometry at the NRTS in Idaho. The gamma spectra were analyzed by computerized techniques using an IBM 360/75 and a PDP-8 interfaced to one of the PHAs. Irradiations were performed in the MTR and the ETR during 1969, 1970, and 1971. After irradiation the hair samples were brought into the laboratory and prepared for gamma counting on the spectrometers. All hair tested had Zn, Na, K, and Br. Eighty-two percent had Se, 50% had Fe, 52% had Ag, 31% had Sb, 22% had Hg, 15% had Sc, 9% had Ce, 1% had Au, 0.9% had Rb. No statistically significant differences were found quantitatively or qualitatively at this sample size. (Diss. Abstr. Int., B) (TSS)

45215 TITANIUM AND CALCIUM CONTENT OF METEORITES. van Zelst, L.; Aten, A. H. W. Jr. (Instituut voor Kernphysisch Onderzoek, Amsterdam). Radiochim. Acta; 17: No. 2, 115-16 (Jul 1972).

The determination of titanium and calcium in meteorites by nondestructive proton activation is reported involving the nuclear reactions $^{48}Ti(p,n)^{48}V$ and $^{44}Ca(p,n)^{44}Sc$. For comparison purposes the calcium content was determined by bremsstrahlung activation involving the reaction $^{44}Ca(\gamma,p)^{43}K$. (D.H.M.)

45216 DETERMINATION OF Mn IN HIGH-PURITY IRON BY NEUTRON ACTIVATION ANALYSIS AFTER PRE-IRRADIATION SEPARATION. Steinnes, E. (Institutt for Atomenergi, Kjeller, Norway). Radiochem. Acta; 17: No. 2, 119-20(Jul 1972).

A method for determining manganese in high-purity iron by neutron activation analysis is reported that includes a preirradiation separation technique based on the removal of iron by anion exchange separation in strong hydrochloric acid for the elimination of the interference from the reaction $^{56}Fe(n,p)^{56}Mn$. (D.H.M.)

45217 TRACE ANALYSIS FOR PLATINUM IN GLASSES BY NEUTRON ACTIVATION. Becker, Donald A. (National Bureau of Standards, Washington, D. C.). Anal. Chim. Acta; 61: No. 1, 1-6(Aug 1972).

Trace amounts of platinum were determined in eight glasses. These glasses were prepared under special conditions, and information on both the surface and interior platinum was desired. Previous microscopic examination of the glass samples had identified platinum on the surface of at least four of the samples. The platinum was analyzed by means of the nuclear reaction $^{198}Pt(n,\gamma)^{199}Pt \xrightarrow{\beta^-} {}^{199}Au$. The ^{199}Au product has a 3.15-day $T_{\frac{1}{2}}$ and E_γ of 158 and 208 keV. Samples were irradiated in the NBSR for 2 h at 1.3×10^{13} n cm^{-2} sec^{-1}. After irradiation, the glasses were etched with aqua regia for the determination of surface platinum, and then dissolved in hydrofluoric and perchloric acids for the determination of interior platinum. The radioactive ^{199}Au was separated from the matrix by spontaneous deposition on metallic zinc. Experimental sensitivities of 0.04 μg of platinum were obtained. (auth)

45218 INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS OF GERMANIUM. Adams, F.; Maenhaut, W.; Hoste, J. (Ghent Univ.). Anal. Chim. Acta; 61: No. 1, 127-31(Aug 1972).

The determination of trace impurities (Co, In, Ni, Sb, Zn, Cr, Ir, Se, Sc, Ag, Ta, Hf, and U) in germanium by instrumental neutron activation analysis with a high resolution Ge(Li) detector is described. Measurements less than 3 weeks after the irradiation were precluded by the high matrix activity. (D.H.M.)

Chemical and Spectral Procedures

45219 (ARH-SA-110) SPECTROPHOTOMETRIC DETERMINATION OF PHOSPHATE IN NUCLEAR MATERIALS. Winters, William I. (Atlantic Richfield Hanford Co., Richland, Wash.). Jan 1972. Contract AT(45-1)-2130. 18p. (CONF-720628-3). Dep. NTIS.

From twenty-seventh ACS northwest regional meeting; Corvallis, OR. (15 Jun 1972).

By extracting molybdophosphoric acid into 1-butyl acetate in the presence of ethylenediaminetetraacetic acid and fluoride, a very simple but selective and sensitive spectrophotometric procedure for phosphate is obtained by measuring the absorbance of the extracted heteropoly acid at 310 nanometers. The optimum acid and reagent concentrations for the method were determined and the effect and tolerance levels of 36 interfering ions, including uranium, thorium, and plutonium, were measured. The method is capable of measuring 0.7 μg of phosphorus and has a molar absorptivity of approximately 25,000. The standard deviation for the method is ±5.4%. This procedure was used to determine the concentration of phosphate in ^{233}U product solutions, to follow the radiolysis of entrained tributyl phosphate and dibutyl phosphate in ^{233}U product solutions, and to determine the phosphate content of nuclear waste solutions. (auth)

45220 (BARC-593) SPECTROCHEMICAL ANALYSIS OF HIGH PURITY CADMIUM. Murty, P. Sreerama; Kaimal, V. N. P. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 14p. Dep. NTIS (U. S. Sales Only).

A spectrographic method using dc arc excitation is described to estimate twelve trace impurities such as As, Sb, etc., in high-purity cadmium oxide. Cadmium metal is converted to oxide and mixed with pure graphite in the ratio 1:1 by weight. Forty milligrams of the mixture are taken in a graphite electrode and excited at a current of 12 amp dc. The spectra are recorded on an Ebert 3.4-meter plane grating spectrograph. The detection limits obtained for various elements range from 1 to 10 ppM. The precision of the method is ±8 to 16%. (auth)

45221 (EUR-4822) TRACE LEVEL DETERMINATION OF OXYGEN IN ORGANIC COOLANTS AND ULTRA-MICRO DETERMINATION OF OXYGEN IN C-H-O ORGANIC COMPOUNDS. Colombo, A. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 1972. 20p. Dep. NTIS (U. S. Sales Only). EUR B.Fr. 40.-.

A method of high sensitivity that requires the use of small samples was developed for determination of the oxygen contained at trace levels in the organic coolants used in nuclear reactors and for the ultra-microanalysis of oxygen-rich organic C-H-O compounds. The weights of the samples used are lower than 30 and 0.5 mg, respectively, and no modification to the apparatus is required for changing from one type of determination to another. The method is based on a catalytic pyrolysis and reduction in hydrogen stream and on the final measurement of the formed water by means of a commercial Keidel electrolytic hygrometer. Although it has not been applied to compounds containing atoms other than carbon, hydrogen, and oxygen, it seems at least theoretically that small and simple variations of the apparatus or of the analytical procedure could render the method able to analyze substances containing other atoms. (auth)

45222 (JEN-229-DQ/I-79) VOLATILIZATION MECHANISM OF CERTAIN ELEMENTS IN A METHOD OF SEMIQUANTITATIVE SPECTROGRAPHIC ANALYSIS. Diaz-Guerra, J. P. (Junta de Energia Nuclear, Madrid (Spain). Division de Quimica). 1972. 18p. (In Spanish). Dep. NTIS (U. S. Sales Only).

The efficiency of the compounds GeO_2, $Li_2B_4O_7$, Li_2CO_3, SiO_2, and $SrCO_3$ as spectrochemical buffers, in the development of a semiquantitative spectrographic method of analysis that can be applied to the determination of 47 elements in different matrices, was tested. By the use of $Li_2B_4O_7$ or GeO_2 adequate accuracy is obtained, and with the latter the detection of much lower concentrations, especially for the elements Mo, Ti, V, and W, was attained. In order to account for the different behavior of these elements, their volatilization mechanism was studied. MoB_2, TiB_2, VB_2, δ-WB, and ϵ-WB were found by x-ray-diffraction analysis to be reaction products in the case of mixtures with $Li_2B_4O_7$. (auth)

45223 (JEN-232-DQ/I-81) APPLICATION OF SPECTROGRAPHIC ANALYSIS TO THE RADIOISOTOPE PRODUCTION CONTROL. II. ANALYSIS OF ^{45}Ca, ^{46}Sc, ^{63}Ni, AND ^{64}Cu SOLUTIONS. Capdevila, C.; Roca, M. (Junta de Energia Nuclear, Madrid (Spain). Division de Quimica). 1972. 19p. (In Spanish). Dep. NTIS (U. S. Sales Only).

Semiquantitative and quantitative determinations of both the radioactive and the target element in each radioisotope are described. The copper-spark technique was used except for Cu determinations, which need silver or graphite electrodes. Interelement effects and their compensation through the use of Bi, Ga, In, Mo, Pd, Tl, and Y as reference elements was examined. For determination of Ca in ^{45}Ca samples, Ba, La, Li and Sr were also tested. Good results were achieved with Li for Ca, Y for Sc, Ti, and Ni, and either In or Y for Cu and Zn. (auth)

45224 (LA-DC-72-524) REMOTIZED APPARATUS FOR DETERMINING OXYGEN IN IRRADIATED REACTOR FUELS AND CLADDING MATERIALS. MacDougall, C. S.; Smith, M. E.; Waterbury, G. R. (Los Alamos Scientific Lab., N. Mex.). 1972. 18p. (CONF-720903-8). Dep. NTIS.

From twentieth remote systems technology conference; Idaho Falls, ID. (17 Sep 1972).

Two well-tested, reliable methods for determining oxygen were modified for hot cell operations and applied to analyses of irradiated materials. In either method the sample is reacted at high temperature with carbon to convert the oxygen to carbon monoxide and dioxide. One reaction furnace is used with either of two analytical finishes to measure traces of oxygen in carbides and claddings or larger amounts in oxide fuels. Unique features in the modified method include: equipment and operations for grinding and pelletizing oxides, techniques for removing sodium and fuel from cladding prior to analysis, a crucible assembly to maximize heating efficiency, and a reaction furnace tube which facilitates easy access to the crucible assembly and trouble-free maintenance. The method and equipment were evaluated by analyzing uranium oxide, mixed oxide fuels having undergone up to 8.5 at. % burnup, metals, carbides, and alloys. There is no known bias. (auth)

45225 COMPARISON OF PRECISION IN SINGLE AND DOUBLE ISOTOPE DILUTION ANALYSIS. Boelrijk, N. A. I. M. (ZWO Laboratorium voor Isotopen-Geologie, Amsterdam). Ann. Soc. Geol. Belg.; 94: No. 2, 105-6(1971). (CONF-710953-2).

From European conference of geochronology: Brussels, Belgium (6 Sep 1971).

Gain in accuracy, due to correction for mass discrimination by double isotope dilution analysis, is obtained at the expense of precision. Loss of precision may be considerable when an unfavorable mixing ratio between spike and unknown was used. A method is

proposed to decide whether the result evaluated by single or by double isotope dilution calculation should be preferred. The decision takes into account the quality of the mass spectrometric analysis and is not based on assumptions concerning the precision of the isotopic ratio determination. (auth)

45226 SEPARATION AND SPECTROPHOTOMETRIC DETERMINATION OF CERIUM AND MANGANESE BY TTA EXTRACTION. Onishi, Hiroshi; Toita, Yukio (Japan Atomic Energy Research Inst., Tokai). Jap. Anal.; 21: No. 6, 756-9(Jun 1972). (In Japanese).

Spectrophotometric methods were previously described for the determination of cerium and manganese with TTA. In these methods, cerium and manganese interfered with each other, the absorbances were measured before and after back-extraction cerium. A method was developed for the separation of cerium and manganese by TTA extraction prior to their spectrophotometric determination with TTA. Cerium(III) is extracted with 0.5 M TTA in xylene at pH 4.3 ± 0.2 (acetate solution). Manganese is then extracted with TTA-acetone-xylene at pH 6 to 7. The cerium and manganese are back-extracted with 1 M nitric acid. The back-extracts are evaporated to dryness, and the residues are treated with nitric and perchloric acids. After oxidation with sodium bromate, cerium(IV) and manganese(III) are extracted with 0.5 M TTA in xylene from 0.5 M sulfuric acid solutions. The absorbance of each extract is measured at 440 nm. The recoveries of cerium(III) and manganese after single extraction with 0.5 M TTA in xylene as a function of pH are shown. About 95% of cerium is extracted at pH 4.1 to 4.5. Manganese begins to be extracted at pH 4.6, and about 80% of manganese is extracted at pH about 6. By this procedure 50 μg of cerium can be determined in the presence of up to 1 mg of manganese. Ten μg of manganese can be determined in the presence of up to 100 μg of cerium. Mixtures containing 100 μg each of cerium and manganese were analyzed six times, and the relative standard deviations were 1.0% for cerium and 3.7% for manganese. Effects of foreign ions on the analysis for cerium and manganese are summarized. (auth)

45227 DETERMINATION OF SMALL AMOUNTS OF MOLYBDENUM BASED ON ITS CATALYTIC EFFECT IN THE METHYLENE BLUE–HYDRAZINE SULFATE REACTION. Yamane, Takeshi; Kitamura, Teruo; Fukasawa, Tsutomu; Suzuki, Takashi (Yamanashi Univ., Kofu, Japan). Jap. Anal.; 21: No. 6, 799-803(Jun 1972). (In Japanese).

A rapid and sensitive method was developed for the determination of small amounts of molybdenum. The method is based on the catalytic activity of molybdenum in the redox reaction between Methylene Blue and hydrazine sulfate. The rates of catalyzed reduction of Methylene Blue by hydrazine sulfate are followed spectrophotometrically by measuring the rate of decolorization of Methylene Blue at 660 nm. A linear relationship $k = k'[Mo]$ was obtained between initial concentration of molybdenum up to 20 μg and the pseudo first order rate constant k evaluated from the plot of log(Methylene Blue concentration) vs. reaction time. Using this relationship, molybdenum for the range 1 to 20 μg in unknown samples can be determined by measurements of reaction rate. Variables in the determination were studied. Of the many ions examined, W(VI) had an accelerating effect on the reaction and hence caused a larger value, while Fe(III) had a decelerating effect even at a few μg level and caused a smaller value. At the stated level, no interference was observed from the other cations. None of the anions and organic acids examined at 5 to 10 mg level interfered. The time required for an analysis is about 20 minutes. The standard deviation at a molybdenum level of 10 μg is 2.2%. (auth)

45228 COMPARISON OF THEORETICAL AND EXPERIMENTAL LIMITS OF DETECTION IN ATOMIC ABSORPTION SPECTROMETRY USING AIR-ACETYLENE AND NITROUS OXIDE-ACETYLENE FLAMES. Parson, M. L.; McElfresh, P. M. (Arizona State Univ., Tempe). Appl. Spectrosc.; 26: No. 4, 472-80(1972).

Limits of detection were calculated for the air-acetylene and nitrous oxide-acetylene flames used in atomic absorption spectrometry using the theoretical treatment developed by Winefordner. Values for the parameters were chosen for these calculations to give the lowest possible limits of detection. These calculated values were compared with experimentally determined limits of detection for 57 elements. Values of the atom fraction, β, are also estimated by means of this comparison. The values for the air-acetylene flame are in fair agreement; however, the comparison of the nitrous oxide flame showed anomalous behavior. An attempt to explain this is made, as well as a general discussion of the results. (auth)

45229 FIRE ASSAY-EMISSION SPECTROGRAPHIC DETERMINATION OF IRIDIUM, RUTHENIUM, AND OSMIUM. Broadhead, K. G.; Piper, B. C.; Heady, H. H. (Bureau of Mines, Reno, Nev.). Appl. Spectrosc.; 26: No. 4, 461-7(1972).

A method is presented for determination of microgram levels of Ir, Ru, and Os in ores, concentrates, and heavy sands. Radiotracers are used to monitor the recovery of these three metals in a 10-mg Pt bead during the normal fire assaying procedure. The Pt bead is arced at 20 A dc in a graphite electrode, and Pt serves as an internal standard. The precision of the method for Ir, Ru, and Os is about 5, 10, and 22% coefficient of variation, respectively. If high accuracy is not required, empirical correction factors may be applied for the assay losses of Ir and Ru, thereby eliminating the need for radiotracers. (auth)

45230 INFRARED ABSORPTION SPECTRA OF POTASSIUM URANIUM FLUORIDES. Soga, T.; Ohwada, K.; Iwasaki, M. (Japan Atomic Energy Research Inst., Tokai). Appl. Spectrosc.; 26: No. 4, 482-3(1972).

Studies were made to obtain information on U–F vibrations in the $Kf-UF_4$ system and to relate the band location of the U–F stretching vibration with the change of valency states of uranium. Observed frequencies and tentative assignments are given. (M.C.G.) (M.C.G.)

45231 MICRODETERMINATIONS OF TERBIUM BY A LUMINESCENT METHOD WITH THE REAGENT PYROGALLOLSULFONIC ACID. Poluektov, N. S.; Alakaeva, L. A.; Tishchenko, M. A. (Inst. of General and Inorganic Chemistry, Odessa). Ukr. Khim. Zh.; 38: No. 2, 175-9(Feb 1972). (In Russian).

The suitability of the luminescent reaction of Tb with pyrogallosulfonic acid as a quantitative method was studied. The Tb complex formed from a 1:1 ratio of Tb:reagent could be excited by a Hg spectrum at the lines 289.4 and 296.7 nm. The sensitivity of the method was 2×10^{-4}% Tb_4O_7. Tb could be determined in a rare earth mixture or admixed with Y_2O_3. (tr-auth)

45232 DETERMINATION OF ALLOYING ADDITIVES IN ARTIFICIAL FLUORITE. Kornienko, T. G.; Endrzheevskaya, S. N. (Inst. of Problems of Materials, Kiev. Inst. of Geochemistry and Physics of Minerals, Kiev). Ukr. Khim. Zh.; 38: No. 2, 194-6(Feb 1972). (In Russian).

The entire quantity of rare earth elements found in an original charge of an artificial fluorite was determined by disintegrating the sample in H_2SO_4 and paper chromatography. The small amounts of additives were completely intruded into the crystalline lattice of the fluorite. (K.S.W.)

45233 PHOTOMETRIC DETERMINATION OF ZIRCONIUM IN NATURAL MATERIALS WITH THE REAGENT PICRAMINE-EPSILON. Dedkov, Yu. M.; Ermakov, A. N.; Korsakova, N. V. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Ind. Lab. (USSR) (Engl. Transl.); 37: No. 12, 1811-12(Dec 1971). Translated from Zavod. Lab.; 37: No. 12, 1411-12(Dec 1971).

A method is described for determination of zirconium in complex geological materials by use of an excess of picramine-epsilon. Spectrophotometric reaction characteristics were calculated. Hf and Nb interfered with the determination. (M.C.G.)

45234 DETERMINATION OF NIOBIUM IN ROCKS, ORES, AND ALLOYS BY ATOMIC-ABSORPTION SPECTROPHOTOMETRY. Husler, John (Univ. of New Mexico, Albuquerque). Talanta; 19: No. 7, 863-9(Jul 1972).

Niobium, in concentrations as low as 0.02% Nb_2O_5, was determined in a variety of materials without separation or enrichment. Chemical and ionization interferences were controlled, and sensitivity increased, by maintaining the iron, aluminium, hydrofluoric acid, and potassium content within certain broad concentration limits. There was close agreement with the results of analyses by emission spectrographic, electron microprobe and x-ray fluorescence methods. (auth)

45235 RAPID MASS-SPECTROMETRIC DETERMINATION OF BORON ISOTOPIC DISTRIBUTION IN BORON CARBIDE. Rein, James E.; Abernathey, Robert M. (Los Alamos Scientific Lab., N. Mex.). Talanta; 19: No. 7, 857-62(Jul 1972).

Boron isotopic ratios were measured in boron carbide by thermionic ionization mass spectrometry with no prior chemical separation. A powder blend of boron carbide and sodium hydroxide was prepared, a small portion transferred to a tantalum filament, the filament heated to produce sodium borate, and the filament transferred to the mass spectrometer where the $^{11}B/^{10}B$ ratio was measured, using the $Na_2BO_2^+$ ion. Variables investigated for their effect on preferential volatilization of ^{10}B included the sodium hydroxide–boron carbide ratio and the temperature and duration of filament heating. A series of boron carbide pellets containing natural boron, of the type proposed for the control rods of the Fast Flux Test Facility reactor, were analyzed with an apparently unbiased result of 4.0560 for the $^{11}B/^{10}B$ ratio (standard deviation 0.0087). The pellets contained over 3% metal impurities typically found in this material. Time of analysis was 45 min per sample, with one analyst. (auth)

45236 FLUOROMETRIC DETERMINATION OF ALUMINUM AND GALLIUM WITH SUPERCHROME GARNET Y. Hiraki, Keizo (Kinki Univ., Osaka). Bull. Chem. Soc. Jap.; 45: No. 5, 1395-9(May 1972).

A sensitive fluorometric determination of aluminum and gallium with Superchrome Garnet Y is described. The reagent reacts with aluminum and gallium to form complexes with reddish yellow fluorescence of emission maximum at 562 and 565 nm, respectively. Several conditions for the determination, such as the pH of the solution, the reagent concentration, the time of standing etc. were investigated, and the composition of the complexes was determined. The maximum fluorescence intensity of the aluminum complex was found at pH 5 (heated for 10 min at 50°C), and that of the gallium complex, at pH 3. The fluorescence was stable at least for 2 hr. By using Superchrome Garnet Y, 0.02 to 4 μg of aluminum and 0.5 to 30 μg of gallium in 25 ml solution could be determined. Scandium and indium also formed fluorescent complexes. Iron(III), cobalt(II), copper(II), zirconium(IV), vanadate(V), and chromate(VI) ions interfered with the determination. (auth)

45237 ACCURACY OF QUANTITATIVE ELECTRON PROBE MICROANALYSIS WITH ENERGY DISPERSIVE SPECTROMETERS. Beaman, D. R.; Solosky, L. F. (Dow Chemical Co., Midland, Mich.). Anal. Chem.; 44: No. 9, 1598-1610(Aug 1972).

The accuracy in the measurement of chemical composition using an energy dispersive spectrometer was determined. After considering a large number of analyses performed by a number of investigators and comparing them with a series of analyses performed, it was concluded that if the concentration is greater than about 20 wt %, a relative error of ±6% of the amount present could be expected. At lower concentration, large positive errors were often encountered. The EDS results were compared with those obtained with a crystal spectrometer. Possible sources of error were examined. (auth)

45238 DETERMINATION OF TRACE QUANTITIES OF VOLATILE FLUORIDE IN URANIUM HEXAFLUORIDE USING AN INFRARED SPECTROPHOTOMETER. Aubeau, Raymond; Blandenet, Gerard; Brogniart, Guy (CEA, Pierrelatte, France). Anal. Chem.; 44: No. 9, 1628-36(Aug 1972).

Determination of volatile fluoride in uranium hexafluoride by infrared spectrophotometry in the range 0.1 to 1 weight parts per million (wppM) is described. The instrument used is a spectrophotometer equipped with a 50-cm-long dual path cell. According to the test accomplished and the sensitivity required, three versions are available: direct analysis; differential analysis; and analysis after absorption on sodium fluoride. These different technologies allow the contents of weight parts per million to be determined with a precision of 5 to 10%. (auth)

45239 SPECTROPHOTOMETRIC MOLYBDENUM DETERMINATION WITH THIOLACTIC ACID. Fritz, J. S.; Beuerman, D. R. (Ames Lab., Iowa). Talanta; 19: No. 3, 366-9(Mar 1972).

A quick, selective method for molybdenum(VI) is described, based on the formation of a yellow thiolactic acid complex. The complex is formed at pH 1.0 to 1.6, and the absorbance is measured at 365 nm. (auth)

45240 PHENYLTHIAZOLYLAZOCHROMOTROPIC ACID AS A PHOTOCOLORIMETRIC REAGENT FOR THORIUM. Pachadzhanov, D. N.; Yusupov, M. Yu. (Inst. of Chemistry, Dushanbe, USSR). Dokl. Akad. Nauk Tadzh. SSR; 15: No. 2, 33-5(1972). (In Russian).

The azo dye, phenylthiazolylazochromotropic acid, is proposed for the photocolorimetric assay of thorium in small quantities. The following agents do not interfere: alkali metals, alkaline earths, Cd, Pb, Co, and the common anions; small quantities of Cu, Fe, Al, Zr, Ti, and Hf do interfere. The wavelength of maximum absorption is: 565 nm for the reagent dye, and 600 nm for the dye-Th complex. (K.S.W.)

45241 ALLOWANCE FOR MASS-SPECTROMETER BACKGROUND AND THE REPRODUCIBILITY IN THE DETERMINATION OF ISOTOPE COMPOSITIONS FOR NITROGEN AND OXYGEN. Vitol, E. N.; Orlova, K. B.; Ivanenko, M. A. Ind. Lab. (USSR) (Engl. Transl.); No. 12, 1888-91(Dec 1971).

Translated from Zavod. Lab.; 37: No. 12, 1466-9(Dec 1971).

The effects of background on isotope analyses of nitrogen, oxygen, and hydrogen were examined by reference to the N_2, CO, and H_2 peaks, which coincide with the strongest background peaks. (M.C.G.)

45242 EXTRACTIVE PHOTOMETRIC DETERMINATION OF URANIUM(VI) IN MINE WATERS (EXCHANGE OF EXPERIENCE). Shchemeleva, G. G.; Stepanenko, Yu. V.; Kovalenko, P. N. (Rostov State Univ., USSR). Ind. Lab. (USSR) (Engl. Transl.); 37: No. 12, 1837(Dec 1971).

Translated from Zavod. Lab.; 37: No. 12, 1431(Dec 1971).

The reaction between the benzoic acid complex anion of uranium and Brilliant Green was studied. The optimum conditions were selected for extraction of the resulting complex with toluene. Beer's law was obeyed over the range of uranium concentration 0.2 to 10.7 μg/ml. Ferric ions interfered, but could be reduced to Fe^{2+} by ascorbic acid. The method could be used for the rapid determination of uranyl in mine waters, without preliminary concentration, for uranium contents from 2×10^{-4} g/liter upwards. (M.C.G.)

45243 AUTOMATIC ANALYSIS BY ABSORPTION SPECTROMETRY. Delmas, Pierre; Imbert, Pierre (to Commissariat a l'Energie Atomique). French Patent 2,070,481. 16 Aug 1971. Filed 5 Dec 1969. (In French).

This automatic spectrophotometric absorption analyzer is intended for the continuous determination of several constituents in liquid samples. Small quantities of ClO_3F, COF_2, UF_6, SiF_4 and ClF_3 can be determined in nitrogen. The apparatus is provided with a luminous source, a transparent tank for the sample, a device for modulating the beam at a given frequency, a grating monochromator, a photoelectric converter, and an amplifier that receives the ac signal from the converter. A rectifier circuit converts the ac signal at the output of the amplifier into a dc amplitude. (France)

45244 ATOMIC ABSORPTION AND FLAME EMISSION SPECTROSCOPY IN THE ANALYSIS OF TRACE METALS IN ATMOSPHERIC PARTICULATES. Hwang, Jae Y. (Instrumentation Lab., Inc., Lexington, Mass.). pp 352-6 of Proceedings of the Second International Clean Air Congress. /Englund, H. M. (ed.). New York; Academic Press, Inc. (1971).

From second international clean air congress conference; Washington, D. C. (6 Dec 1970). See CONF-701229.

Analytical conditions of flame and flameless atomic spectroscopy for trace analysis of samples were developed by performing simultaneous analysis of two elements as an approach to multielement analysis; improving accuracy of the analytical results by reducing or eliminating chemical interferences by optimizing experimental conditions; improving the precision of the analysis by utilizing internal standardization techniques; increasing the sensitivities and minimizing sample solution for the analysis by a flameless absorption measurement; and increasing the sensitivities of the analysis by improving the nebulization efficiency with the counter jet device. Detection limits are given for eighteen elements in air samples including Mo. (D.H.M.)

45245 STABLE ISOTOPES OF CARBON AS INDICATORS OF AIR POLLUTION LEVELS. Atkins, Patrick R. (Univ. of Texas, Austin). pp 545-9 of Proceedings of the Second International Clean Air Congress. /Englund, H. M. (ed.). New York; Academic Press, Inc. (1971).

From second international clean air congress conference; Washington, D. C. (6 Dec 1970). See CONF-701229.

Preliminary studies indicate that the stable carbon isotope ratios found in polluted air samples can be used to determine the degree of pollution in the area and the type of source from which the majority of the pollution originated. The cold trap method of separating the CO_2 fraction from the gas sample works well and gives reproducible results. However, the method is cumbersome and relatively slow. The precipitation method using barium hydroxide is much more convenient and requires less equipment. But the results to date are not reproducible and cannot be interpreted directly. A calibration procedure will probably be required before the precipitation method can be used to produce useful data. (auth)

45246 ELECTRON PROBE MICROANALYSIS. Philibert, J. (Institut de Recherches de la Siderurgie, St. Germain-en-Laye, France). pp 419-531 of Modern Analytical Techniques for Metals and Alloys. Pt. 2. /Bunshah, R. F. (ed.). New York; John Wiley and Sons, Inc. (1970).

Topics reviewed include: production of the electron probe, analysis of the emitted x rays, ancillary techniques, image display, generated intensity of the primary characteristic lines, general outline of correction calculations, correction calculation methods, statistical errors connected with photon emission, errors associated with the line spectrum, counter errors, errors associated with the electron beam, and erorrs associated with the specimens. (161 references) (M.C.G.)

45247 EMISSION SPECTROSCOPY INCLUDING dc ARC, SPARK, AND OTHER METHODS. Mossotti, Victor G. (Univ. of Illinois, Urbana). pp 533-72 of Modern Analytical Techniques for Metals and Alloys. Pt. 2. /Bunshah, R. F. (ed.). New York; John Wiley and Sons, Inc. (1970).

Topics covered include: origin of spectra, atomic structure, spectral characteristics of families of elements, excitation of

spectra, energy sources, measurement of spectra (external optics, wavelength dispersion, transducers), interpretation of spectra, and practical analytical procedures. (63 references) (M.C.G.)

45248 MASS SPECTROMETRIC TECHNIQUES. Honig, Richard E. (RCA Labs., Princeton, N. J.). pp 573-640 of Modern Analytical Techniques for Metals and Alloys. Pt. 2. /Bunshah, R. F. (ed.). New York; John Wiley and Sons, Inc. (1970).

The various mass spectrometric techniques used in the analysis of metals and alloys are discussed, with special emphasis on recent developments. Topics covered include: ion sources, mass analyzer, ion detectors, analytical methods, experimental limitations, data processing, and applications. (223 references) (M.C.G.)

45249 SECONDARY ION EMISSION ANALYSIS. Philibert, J. (Institut de Recherches de la Siderurgie, St. Germain-en-Laye, France). pp 641-56 of Modern Analytical Techniques for Metals and Alloys. Pt. 2. /Bunshah, R. F. (ed.). New York; John Wiley and Sons, Inc. (1970).

Applications of secondary ion emission to localized analysis of massive specimens are discussed. Three modes of operation can be used: depth analysis, ion microscopy, and ion probe. Instrumentation, characteristics of secondary ion emission analysis, problems associated with qualitative and quantitative chemical analysis, and examples are discussed. (12 references) (M.C.G.)

45250 PHYSICAL METHODS OF CHEMISTRY. PART IIIB. Weissberger, Arnold; Rossiter, Bryant W. (eds.). Techniques of Chemistry. Volume I. New York; John Wiley and Sons, Inc. (1972). 726p.

Separate abstracts were prepared for two of the eight chapters. The remaining chapters consider infrared spectroscopy, Raman spectroscopy, visible and ultraviolet spectrophotometry, determination of fluorescence and phosphorescence, and spectroscopy of monolayer assemblies. (D.H.M.)

For abstracts of individual chapters see: 45251 and 45340.

45251 ATOMIC ABSORPTION SPECTROSCOPY. Ambrose, Robert T. (Eastman Kodak Co., Rochester, N. Y.). pp 485-520 of Physical Methods of Chemistry. Pt. IIIB. /Weissberger, Arnold (ed.). New York; John Wiley and Sons, Inc. (1972).

A review of atomic absorption spectroscopy is presented that includes theory, scope of the method (sensitivities and detection limits for 68 elements including Ce, Cs, Dy, Er, Eu, Gd, Ho, La, Lu, Mo, Nd, Nb, Pr, Ru, Sm, Sc, Sr, Th, Ta, Te, Tb, Tm, Y, Yb, U, and Zr), equipment, experimental techniques, and applications. (D.H.M.)

45252 ANALYTICAL EMISSION SPECTROSCOPY. PART I. Grove, E. L. (ed.). Analytical Spectroscopy Series. Volume 1. New York; Marcel Dekker, Inc. (1971). 413p. $26.50.

A treatise concerned with the uses of emission spectroscopy and the new advances, changes, and consolidation of ideas in the field is presented. Chapters on principles and instrumentation include the basic physics of optics and the development of principles and instrumentation from earlier instruments to those in use today. Areas considered are: historical development, some uses and definitions; origins of atomic spectra; prism systems, spectrographs, and spectrometers; gratings and grating instruments; and spectroradiometric principles. (D.H.M.)

45253 ANALYTICAL EMISSION SPECTROSCOPY. PART II. Grove, E. L. (ed.). Analytical Spectroscopy Series. Volume 1. New York; Marcel Dekker, Inc. (1972). 579p. $35.75.

A treatise concerned with the uses of emission spectroscopy and the new advances, changes, and consolidation of ideas in the field is presented. Areas covered are: excitation of spectra; flame spectrometry; qualitative and semiquantitative analysis; and quantitative analysis. (D.H.M.)

45254 DETERMINING BORON IN GLASS BY FLAME EMISSION SPECTROSCOPY. Morrow, Roy W. (Oak Ridge Y-12 Plant, Tenn.). Anal. Lett.; 5: No. 6, 371-6(1972).

A method was developed that will determine the percentage quantities of boron in borosilicate glass by flame emission spectroscopy. Raschig rings of borosilicate glass are used as neutron absorbers during the processing and shipping of radioactive solutions. Since the effectiveness of these rings is dependent on the boron content, analytical control is a necessity. The sample is dissolved in hydrofluoric acid, nebulized into a nitrous oxide-acetylene flame, and a measurement made of the BO_2 band emission at 5180 angstroms. Glass containing at least 1.0 wt% boron can be analyzed. The relative standard deviation of the method is 5.1%. Approximately 10 samples (2 aliquots each) can be analyzed in four hours. (auth)

45255 DETERMINATION OF SILICA IN SILICATES CONTAINING PHOSPHORUS, TITANIUM, AND ZIRCONIUM. Ohlweiler, O. A.; Meditsch, J. O.; Silveira, Carmem L. P.; Silva, Sandra (Instituto de Quimica, Porto Alegre, Brazil). Anal. Chim. Acta; 61: No. 1, 57-65(Aug 1972).

A procedure based on precipitation of oxine 12-molybdosilicate was examined for the determination of silica in silicates containing phosphorus, titanium, and zirconium. Boron trioxide and lithium carbonate are used in the flux. The fusion product is dissolved in 0.01M hydrochloric acid containing EDTA, in contact with Amberlite IR-120 (H^+). The resultant solution, after stirring with Amberlite IRA-400 (HCO_3^-), is used for the precipitation of silica as oxine 12-molybdosilicic acid. (auth)

45256 POLAROGRAPHIC DETERMINATION OF TIN IN COPPER-, ALUMINUM-, AND ZIRCONIUM-BASE ALLOYS. Mukoyama, Tomoyuki; Yamane, Takeshi; Kiba, Nobutoshi; Tanaka, Masao (Yamanashi Univ., Takeda, Japan). Anal. Chim. Acta; 61: No. 1, 83-8(Aug 1972).

An alternating-current polarographic method is described for determining tin in copper-, aluminum- and zirconium-base alloys. With EDTA as masking agent and coprecipitation with beryllium hydroxide, tin is separated selectively from other metal ions and determined polarographically in a 3M hydrochloric acid as supporting electrolyte. The method is simple, selective and accurate. A single determination takes about 45 min. (auth)

45257 NANOGRAM DETERMINATION OF IODIDE BY MEANS OF ISOTOPE EXCHANGE. Gabrielsson, Ann-Britt; Beronius, Per (Univ. of Umea, Sweden). Anal. Chim. Acta; 61: No. 1, 123-6(Aug 1972).

A study is reported on using the isotope exchange reaction $CH_3I + Na^{131}I \rightleftharpoons CH_3{}^{131}I + NaI$ to determine nanogram quantities of iodide. Results indicate that amounts down to 50 ng may be determined with only a few percent error. (D.H.M.)

45258 DEPENDENCE OF THE FORMATION OF URANIUM AND THORIUM IONS AND THEIR OXIDE IONS ON VARIOUS CONDITIONS OF THERMAL IONIZATION. Heumann, K. G. (Technische Hochschule, Darmstadt, Ger.). J. Mass Spectrom. Ion Phys.; 9: No. 3, 315-24(Aug 1972). (In German).

The dependence of the formation of uranium ions, thorium ions, and their oxide ions on various conditions of thermal ionization was investigated. A single-focusing mass spectrometer with a double-filament thermal ion source was used. The filaments were made of rhenium. The samples were applied in the form of uranyl nitrate and thorium nitrate. The temperatures of the ionization filament and the evaporation filament were varied. It was found that the best conditions to measure the isotopic ratio were achieved if the difference in temperature between the ionization filament and the evaporation filament is as high as possible. The isotopic ratios of uranium and thorium were determined by measuring the ions Th^+ and U^+ rather than the ions ThO^+ and UO^+. In addition the mass discrimination during the evaporation of the sample was investigated. The precision of the isotopic ratio measurements is shown by the determination of the ratio $^{234}U/^{235}U$ in natural uranium and of the ratio $^{230}Th/^{232}Th$ in a ^{230}Th solution. (auth)

45259 SYSTEMATIC STUDY OF THE DECOMPOSITION OF VERY SMALL QUANTITIES OF RARE EARTH OXIDES BY MASS SPECTROMETRY. Nguyen Long-Den; de Saint-Simon, M. (Institut de Physique Nucleaire, Orsay, France). J. Mass Spectrom. Ion Phys.; 9: No. 3, 299-314(Aug 1972).

The ratio $i(M^+)/i(MO^+)$ was measured as a function of temperature by mass spectrometry. Thermal ionization of small quantities of rare earth oxides, which were deposited on a rhenium filament, was used. The results are interpreted starting from the decomposition of the monoxides, their reduction by rhenium, and the thermal ionization of the products formed. The quantities that entered into the calculations were the dissociation energy $D_0^0(MO)$ and the atomic number Z of the investigated element. Good agreement was obtained with experimental results. With this method it seems possible to determine the dissociation energy $D_0^0(MO)$ and to detect the presence of crystal transformation of an element in very small quantities. As an application, these results should permit one to identify for lanthanides both Z and A simultaneously, since A is determined by the magnetic field of the mass spectrometer. (auth)

45260 ANALYSIS OF CURIUM AND CALIFORNIUM BY SINGLE-EXPOSURE SPARK SOURCE MASS SPECTROMETRY. Chastagner, P.; Tiffany, B. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Contract AT(07-2)-1. J. Mass Spectrom. Ion Phys.; 9: No. 3, 325-32(Aug 1972).

Single-exposure spark source mass spectrometry is used for routine quality control analyses of ^{244}Cm and ^{252}Cf at the Savannah River Laboratory. All elements above mass 10, except carbon, nitrogen, oxygen, and the noble gases, are determined as are the isotopic distributions of fission products ruthenium, palladium, cerium, neodymium, samarium, europium, gadolinium, dysprosium,

and erbium. Samples of from 1 to 30 μg of curium and 0.0001 to 0.1 μg of californium are mounted on gold electrodes for analysis. Indium is added as an internal standard to californium samples smaller than 0.005 μg, and ytterbium is added as an internal standard to all samples when photometric or refined visual interpretation is required. Visual interpretation usually yields impurity results accurate within a factor of three and relative standard deviations for isotopic distributions of about 35%. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts: 45585, 45587, and 45604.

45261 (ICRU–22) MEASUREMENT OF LOW-LEVEL RADIOACTIVITY. (International Commission on Radiation Units and Measurements, Washington, D. C.). 1 Jun 1972. 66p. ICRU Publications, Washington, D. C. $3.50.

The assay of gamma- and x-ray emitters is discussed under the headings: composition and reduction of background, scintillation counters, semiconductor detectors, proportional counters, special techniques, and analysis of gamma spectra. Topics discussed concerning the assay of beta emitters include gas-discharge counters, plastic scintillation counters, liquid scintillation counters, Cherenkov counters, semiconductor detectors, and procedures for specific radionuclides. The assay of alpha emitters is discussed including background, sensitivity, classification of alpha particle detection techniques, measurement of total emission rate of α particles in solid sources, measurement of α particle emitters in the gaseous phase, spectrometry of alpha particles, and the nuclear-track technique. Also, standardized sources and reference sources for low-level procedures are briefly discussed. An extensive list of references is included. (W.H.K.)

45262 (NIM–1427) PRESSED FUSED DISC: A TECHNIQUE FOR THE PREPARATION OF ORE SAMPLES TO BE ANALYSED FOR URANIUM BY X-RAY FLUORESCENCE. Austen, C. E.; Russell, B. G. (National Inst. for Metallurgy, Johannesburg (South Africa)). 28 Mar 1972. 8p. Dep. NTIS (U. S. Sales Only).

Because of the structure of some uranium minerals, erroneous results are sometimes obtained when x-ray-fluorescence measurements are made on the powdered rock. Samples are therefore fused, prior to analysis, with sodium tetraborate or lithium tetraborate. A modified fusion technique is described in which the rock sample is fused with fluorspar and lithium tetraborate, and the melt is pressed into a disc. The precision of x-ray-fluorescence analyses for uranium on the pressed fused discs is shown to be similar to that on discs prepared in the old way, but the preparation of the modified discs is much simpler and quicker. (auth)

45263 (RT/PROT–72–11) MEASUREMENT OF ^{137}Cs AND ^{90}Sr IN SOIL. Bagliano, G.; Fratarcangeli, S.; Lalli, M. G.; Toeroek, I. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 30 Mar 1972. 27p. (In Italian). Dep. NTIS (U. S. Sales Only).

An analytical method is described for determination of ^{90}Sr, Ca, ^{137}Cs, and K in soil samples of different chemical composition. Also reported are the results of analysis performed on 30 soil samples taken at several different sampling points. (auth)

45264 (SRARI-P–123) DETERMINATION OF THE CONCENTRATION OF GAMMA-EMITTING ISOTOPES IN EXTENDED SOURCES WITHOUT SAMPLING. Polyakov, V. I.; Chechetkin, Yu. V. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1971. 28p. (In Russian). Dep. NTIS (U. S. Sales Only).

A scintillation γ spectrometer with a collimator is used to measure bulk and surface concentrations of isotopes in different source configurations including cylindrical ones. Analytical expressions are given enabling, as it is shown experimentally, specific activity determination with an error of 10 to 15%. The methods of calibrating a scintillation spectrometer without a collimator are described. (auth)

45265 (UCRL–51061(Vol.1)) COMPUTERIZED QUANTITATIVE ANALYSIS BY GAMMA-RAY SPECTROMETRY. VOLUME I. DESCRIPTION OF THE GAMANAL PROGRAM. Gunnink, R.; Niday, J. B. (California Univ., Livermore. Lawrence Livermore Lab.). 1 Mar 1972. Contract W-7405-eng-48. 78p. Dep. NTIS.

GAMANAL provides a complete qualitative and quantitative analysis of mixtures of radioactive species by computer interpretation of high-resolution gamma spectra. This volume describes the methods used for determining background, resolving and fitting complex peak groupings, determining the energies and absolute intensities of the gamma rays, and determining the amounts of the source nuclides. The latter are identified with the aid of a preprocessed decay-scheme library, and all interferences are resolved by a least-squares solution of the matrix of equations for the gamma intensities. (auth)

45266 IMPROVED METHOD FOR DETERMINATION OF ^{35}S IN PLANT MATERIAL USING OXYGEN FLASK COMBUSTION AND LIQUID SCINTILLATION COUNTING. Grundon, Noel J. (Univ. of Queensland, St. Lucia, Australia); Asher, Colin J. J. Agr. Food Chem.; 20: No. 4, 794–8(1972).

A safe oxygen flask combustion procedure is described for preparation of ^{35}S-labeled plant material for liquid scintillation counting. Hazards associated with flammable absorbing solutions are eliminated by using deionized water to trap the sample combustion products from the oxygen flask. Sulfur-35 activity in the resulting aqueous solution is then determined in a 1:1:2 mixture of toluene, Triton X-100, and water with an efficiency of 73%. With a 3-liter oxygen flask and a 20-min absorption period, the relationship between sample size and activity recovered was linear up to a sample weight of 1.2 g. Recoveries of ^{35}S added to plant material as sodium sulfate-^{35}S or cysteine hydrochloride-^{35}S were 100.0 ± 2.3% and 99.1 ± 1.2%, respectively. Using five combustion flasks and an automatic liquid scintillation counter, a single operator can process about 50 samples per day. (auth)

45267 APPARATUS FOR MEASURING THE D_2O CONTENT IN A FLOW OF WATER. Strindehag, O. M. (to Aktiebolaget Atomenergi). Canadian Patent 893,931. 22 Feb 1972. Priority date 30 Oct 1969, Sweden.

The D_2O content of a flow of water is measured by passing the flow through a measuring chamber containing a gamma-radiating body consisting of a long-lived radioactive isotope in radioactive equilibrium with a short-lived radioactive gamma-radiating affiliated isotope having a gamma energy of more than 2.23 MeV. Photoneutrons are formed as a result of the heavy hydrogen's being bombarded with high-energy gamma photons. The photoneutrons are detected and counted by means of a neutron detector. (Canada)

45268 DETERMINATION OF Pu IN THE ENVIRONMENT BY EXTRACTION AND LIQUID SCINTILLATION COUNTING. Ghysels, J. P. Ind. At. Spatiales; 26: No. 1, 33–6(Jan 1972). (In French and English).

The extraction of Pu was effected with liquid ion exchangers (e.g., tertiary amines such as triisooctylamine). The Pu was put back into organic solution by extraction with DEHPA. After mixing with a liquid scintillator, the counting yield was determined (close to 100%). This method of analysis is intended for determination of Pu in biological substances. It was applied to the analysis of radioactive dusts of different origin. (France)

45269 NONDESTRUCTIVE ASSAY OF POWER REACTOR FUEL ASSEMBLIES. Weisbin, C. R. (Los Alamos Scientific Lab., N. Mex.); Augustson, R. H.; Hendricks, J. S.; (and others). Nucl. Technol.; 15: No. 3, 455–61(Sep 1972).

The total ^{235}U content of low enrichment power reactor fuel assemblies was determined by interrogation with Li(p,n) neutrons (200 to 500 keV) produced by a Van de Graaff proton accelerator and by measurement of fission induced delayed neutrons. To extend the application of this assay technique and to optimize its implementation, numerical calculations were performed using a modified Monte Carlo approach. Experimental measurements from a BWR-type fuel assembly verified the mathematical model employed. By incorporating results from both calculation and measurement, a system is being designed to assay the total ^{235}U content of power reactor fuel elements with an overall uncertainty within 2%. Using commercially available fuel handling equipment, the analysis time for the entire element is estimated to be approximately 30 minutes. (auth)

45270 X-RAY FLUORESCENCE ANALYSIS OF HEAVY ELEMENTS BY AN α–X COINCIDENCE METHOD. Aleksandrov, B. M.; Solov'ev, S. M.; Tyvin, L. I.; Eismont, V. P. At. Energ. (USSR); 32: No. 6, 491–3(Jun 1972). (In Russian).

The method of α–x coincidence was used to determine small quantities of ^{241}Am, $^{242-244}$Cm, and ^{252}Cf by using the characteristic L radiation that accompanies α decay. Typical spectra of α particles from the targets mentioned and of L radiation are plotted. (3 figures) (K.S.W.)

45271 ELASTIC NUCLEAR SCATTERING TECHNIQUES. Rubin, Sylvan (Stanford Research Inst., Menlo Park, Calif.). pp 657–85 of Modern Analytical Techniques for Metals and Alloys. Pt. 2. /Bunshah, R. F. (ed.). New York; John Wiley and Sons, Inc. (1970).

The theory of the method, including velocity change on scattering, scattering cross section, stopping power, and scattering yield, is discussed. Equipment and measurement problems and limitations are described. (20 references) (M.C.G.)

45272 RADIOMETRIC DETERMINATION OF TRACE AMOUNTS OF ANIONIC SURFACTANTS IN GROUND WATER AND POTABLE WATER. Taylor, C. G.; Waters, J. (Liverpool Polytechnic). Analyst; 97: No. 1156, 533-41(Jul 1972).

The water sample is treated with an excess of ferroin solution labelled with iron-59. The solution is extracted with chloroform and the activity of a portion of the extract is measured. The anionic surfactant content of the sample is determined by the standard addition of sodium lauryl sulphate. The application of the method to river-water and tap-water samples gives results that agree with those obtained by using Abbott's methylene blue method. The present method requires 30 minutes for each reading, i.e., blank, sample, or sample plus standard. The over-all standard deviation for river-water samples was calculated to be ±4.3% at the level of 0.1 ppM of sodium lauryl sulphate. The limit of detection is 0.1 μg of sodium lauryl sulphate (0.005 ppM in a 20-ml sample). This limit is the equivalent of the average blank. Blanks are minimized by extracting at pH 4 with chloroform equilibrated with water, by performing only one extraction, by centrifuging for a fixed period and by removing the extract for counting with a capillary device. No species have been found to interfere when present at the levels that are normally encountered in river waters. Potential interferences by fluoride or iron are compensated for by the internal standard. (auth)

Separation Procedures

Refer also to abstracts: 45302 and 47014.

45273 (UJV-2820-Ch) STRONTIUM SORPTION ON THE SORBENTS OF $BaSO_4$–$CaSO_4$ SYSTEM. Vojtech, O.; Selucka, H. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). 1972. 29p. Dep. NTIS (U. S. Sales Only).

The sorption of strontium on sorbents of the $BaSO_4-CaSO_4$ system was studied in detail over the whole concentration range of this binary system. The sorbents were prepared by two different methods of thermal treatment which led to a formation of stable and metastable polycrystalline powders. Besides the kinetics of sorption, also course of dissolution of the $CaSO_4$ component was studied and specific surface areas of metastable sorbents were measured. Results led to conclusions which explain some specific sorption properties of the studied sorbents. Metastable mixed crystals $BaSO_4-CaSO_4$ with a higher content of $CaSO_4$ were found to be good sorbents of strontium, regardless of the type of their crystal lattices. (auth)

45274 ZIRCONIUM TETRAFLUORIDE PROCESS. Craigen, W. J. S.; Joe, E. G.; Ritcey, G. M.; Melvanin, F. W.; Smart, B. C. (to Eldorado Nuclear Ltd.). Canadian Patent 899,029. 2 May 1972.

Anhydrous zirconium tetrafluoride can be prepared by preparing a clear solution of zirconyl nitrate in a nitric acid solution (at least 8N, with zirconium content between 50 and 150 g/l), precipitating zirconium tetrafluoride monohydrate by adding hydrofluoric acid at a temperature of at least 30°C, isolating and drying the precipitate, and using acid solution remaining after precipitation for the preparation of the zirconyl nitrate solution. Recycling of the acid solution must be accompanied by a bleed to prevent too much build-up of metallic impurities such as titanium or uranium salts of higher solubility than zirconium tetrafluoride. This removal of a portion of the reused acid also, when the feed material is zirconyl nitrate, prevents the nitrate ion concentration from becoming excessively high. Greater than 90% recovery of the metal ion from solution may be obtained from this process. (E.M.T.) (Canada)

45275 PAPER CHROMATOGRAPHY OF THE RARE EARTH ELEMENTS WITH THE DEVELOPER CONTAINING OF ETHYLENE GLYCOL MONETHERS, HYDROPHOBIC SOLVENTS, AND OXINE. Nagai, Hideo; Deguchi, Toshio; Nakai, Kiyoto (Kumamoto Univ., Japan). Jap. Anal.; 21: No. 6, 788-93(Jun 1972). (In Japanese).

Separation of lanthanides (from La to Tb) was carried out on filter paper (Toyo Roshi No. 5B, 1.5 × 30 cm) impregnated with potassium chloride. Developing solvents used consisted of ethylene glycol monoether, oxine, acetate buffer and hydrophobic solvents such as chloroform. Test solutions of lanthanides were prepared by dissolving their nitrates in 1M nitric acid containing 2.0 to 2.5 mg of each ion per ml of the solution. About 0.2 μl of test solution was applied at the starting position of the filter paper strip in a narrow straight line and then developed as the usual ascending paper chromatography. The following five kinds of developers were used: (A) 55 ml of carbitol, 15 ml of 1M acetic acid–1M sodium acetate buffer (pH ca. 5), 30 ml of chloroform and 4.0 g of oxine, (B) 55 ml of carbitol, 15 ml of the acetate buffer (pH ca. 5), 30 ml of chloroform, and 3.5 g of oxine, (C) 45 ml of methyl cellosolve, 10 ml of the acetate buffer (pH ca. 4.5), 45 ml of chloroform and 2.0 g of oxine, (D) 40.5 ml of methyl cellosolve, 7.5 ml of the acetate buffer (pH ca. 4.5), 52 ml of chloroform and 2.5 g of oxine, and (E) 50 ml of cellosolve, 15 ml of the acetate buffer (pH ca. 4), 35 ml of chloroform and 2.0 g of oxine. Using the developer A or D, quaternary mixtures such as La–Ce–Pr–Nd were sufficiently separated. With the developer B the separation of Sm–Eu–Tb or Nd–Gd–Tb was achieved. Separation of La–Ce–Pr–Sm was possible by using the developer C. Separation of La–Ce–Pr, Ce–Pr–Sm, Nd–Sm–Gd or Eu–Tb was also possible with the developer E. In these five developers, A and D showed the most widely applicable properties. When a hydrophobic solvent such as chloroform was increased in a developer, the R_f value of the ionic band was depressed reducing the tailing of the band. Accordingly, the optimum addition of chloroform was investigated to obtain the maximum difference of the R_f values between the two adjacent bands maintaining the minimum tailing of their bands. These optima were usually obtained at a slight excess addition of chloroform beyond the saturation of the developers. The hydrophobic solvents investigated other than chloroform were carbon tetrachloride, benzene, 1-butanol, 1-butyl acetate, diethyl ether, and ethyl methyl ketone, but chloroform showed the best result of all the developers used in this experiment. (auth)

45276 SUBSTANCE PURIFICATION BY ZONE MELTING IN A ROTATING CONTAINER. Kirgintsev, A. N.; Lastushkin, N. I.; Rybin, Yu. A.; Avvakumov, E. G. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, No. 9, Ser. Khim. Nauk; No. 4, 54-60(Jul 1971). (In Russian).

Zone-purification plants designed as rotating containers around a horizontal axis or an axis located at a certain angle to the main horizon are described. The features of containers are described and the representative examples of substance (germanium, bismuth, antimony, tellurium) purification are given. High-speed (over 140 revls/min) and not low-speed (1–5 revls/min) is believed to be in order for zone purification. (auth)

45277 SOLVENT EXTRACTION OF EUROPIUM BY VERSATIC ACID 911. Shigematsu, Tatsuhiko; Nishimura, Sanji; Tanabe, Teruo; Kondo, Yoshio (Kyoto Univ.). J. Jap. Inst. Metals; 36: No. 5, 445-50(May 1972). (In Japanese).

Equilibrium in the solvent extraction of europium by Versatic Acid 911 was studied. The organic phase was composed of Versatic Acid and benzene, and the aqueous solution of Eu $(NO_3)_3$ and HNO_3 was used. The ionic strength of the latter solution was maintained at unity by adding $NaNO_3$. Radioactive ^{152}Eu was used as a tracer. From the measurements carried out at 25°C, the equation of extraction and the apparent equilibrium constant was determined as follows: Eu^{3+} (aq) + 3.5 R_2H_2 (org) → $EuR_3 \cdot 4$ RH (org) + 3 H^+ (aq) and $K = [EuR_3 \cdot 4\ RH]_0\ [H^+]^3_{aq}/[Eu^{3+}]_{aq}\ [R_2H_2]^{3.5} = 1.12 \times 10^{-3}$ where R_2H_2 refers the dimeric form of Versatic Acid in benzene solution. (auth)

45278 THIN-LAYER CHROMATOGRAPHY OF METAL IONS ON MICROCRYSTALLINE CELLULOSE IMPREGNATED WITH POTASSIUM CHLORIDE. Ishida, Koji (Kyorin Univ., Hachioji, Japan); Nakagomi, Yoshihito. Jap. Anal.; 21: No. 6, 810-12 (Jun 1972). (In Japanese).

Thin-layer chromatographic behavior of 32 metal ions on microcrystalline cellulose, Avicel SF, as well as that impregnated with potassium chloride was investigated in ethanol-6M hydrochloric acid media. R_f values of most ions on the latter thin-layer decreased with increasing ethanol concentration. This chromatographic behavior suggests that the formation of anionic chloro complexes and of slightly soluble potassium double salts may be responsible for the distribution of the metal ions on the microcrystalline cellulose impregnated with potassium chloride. The chromatographic system involving the chloride impregnated layer makes it possible to accomplish many separations of analytical interest which are difficult on the pure cellulose. (auth)

45279 RADIOMETRIC INVESTIGATION OF THE ABSORPTION OF POTENTIAL-DETERMINING IONS FROM AQUEOUS SOLUTIONS OF NON-IONOGENIC SURFACE-ACTIVE SUBSTANCES. Kabysh, G. M.; Aleinikov, V. G.; Glazman, Yu. M.; Strazhesko, D. N. (Kiev Technological Inst. of Light Industry. Inst. of Physical Chemistry, Kiev). Ukr. Khim. Zh.; 38: No. 2, 163-4(Feb 1972). (In Russian).

The absorption of I^- ions by AgI powder in the presence of a series of alkyl ethers of polyethylene glycol with different lengths of hydrocarbon radicals and oxyethylene chains was studied. The labeled KI solution contained about 75% of ^{131}I, and as a result of isotopic exchange the activity of the KI decreased by a factor of ten. On addition to the solution of different nonionogenic surface active substances, the potential-determining I^- ions were not desorbed from the surface of the AgI. (tr-auth)

45280 SEPARATION OF THE RARE EARTH ELEMENTS BY ANION EXCHANGE. I. ANION EXCHANGE RESIN SEPA-

RATION OF Gd, Eu, Sm, Nd, AND Pr IN METHANOL–ACETIC ACID–NITRIC ACID MIXTURES. Kurokawa, Kazuo (Tokyo Metropolitan Hakuo Senior High School); Kakihana, Hidetake. Nippon Kagaku Kaishi; No. 5, 925-9(May 1972). (In Japanese).

Ion exchange separation of gadolinium, europium, samarium, neodymium, and praseodymium was studied using mixed solutions of methanol–acetic acid–nitric acid. Satisfactory separation was obtained with the anion exchange resin column of Amberlyst-A 29 (nitrate form). The rare earths were strongly adsorbed on the top of the column from solutions consisting of 90% methanol, 5% glacial acetic acid, and 5% 7 mol/l nitric acid. Then, Gd, Eu, Sm, Nd, and Pr were eluted in this order by passing successively the four kinds of eluents: (flow rate: 0.7 to 0.8 ml/min). (1) MeOH-17 mol/l HOAc-7 mol/l HNO_3 (volume ratio: 90 : 5 : 5). (2) MeOH-10 mol/l HOAc-7 mol/l HNO_3 (80 : 15 : 5). (3) MeOH-8 mol/l HOAc-7 mol/l HNO_3-H_2O (75 : 15 : 5 : 5) and (4) H_2O. It is confirmed that up to 0.007 mmol of Gd, Eu, Sm, Nd, and Pr are satisfactorily separated with a column of 1.1 cm diameter and 21 cm length. (auth)

45281 RAPID SEPARATION OF METAL CHELATES BY COLUMN LIQUID–LIQUID CHROMATOGRAPHY USING ULTRAVIOLET DETECTION. Huber, J. F. K. (Univ., Amsterdam); Kraak, J. C.; Veening, Hans. Anal. Chem.; 44: No. 9, 1554-9(Aug 1972).

The separation of metal–β-diketonates was accomplished by column liquid–liquid chromatography. Included in the study are the acetylacetonates and the trifluoroacetylacetonates of Be(II), Al(III), Cr(III), Fe(III), Co(II), Co(III), Ni(II), Cu(II), Zn(II), Zr(IV), and Ru(III). A ternary liquid–liquid system composed of water, 2,2,4-trimethylpentane, and ethanol was employed. The water-rich phase was used as the stationary medium while the water-poor phase served as eluent. Several of these two phase systems, varying in quantitative composition, were evaluated for chromatographic selectivity. The addition of a trace of chelating ligand to the phase system suppressed undesirable hydrolysis reactions of chelates. A six-component mixture of metal acetylacetonates can be separated in less than 25 minutes. (auth)

45282 COMBINED ION EXCHANGE-SOLVENT EXTRACTION (CIESE) STUDIES OF METAL IONS ON ION EXCHANGE PAPERS. SYNERGISTIC EFFECTS AND CHROMATOGRAPHIC SEPARATIONS. De, Anil K.; Bhattacharyya, Chitta R. (Dept. of Chemistry, Visva-Bharati, India). Anal. Chem.; 44: No. 9, 1686-8(Aug 1972).

SA-2 and SB-2 ion exchange papers were used to describe several selected chromatographic systems. Cation exchange systems, anion exchange systems, and synergistic effects are discussed. Separations achieved are given for Nb–Ce–La, Zr–Ce–Th, and V–Nb–Ta systems. (M.C.G.)

45283 SELECTIVE ION EXCHANGERS WITH ISONITROSOACETAMIDE FUNCTIONAL GROUPS. II. PROPERTIES AND APPLICATION. Sykora, V.; Dubsky, F. (Inst. of Chemical Tech., Prague). Collect. Czech. Chem. Commun.; 37: No. 5, 1504-13(May 1972).

Selective ion exchangers with isonitrosoacetamide functional groups (–NH · CO · CH=NOH) attached to a polycondensate of m-aminophenol with formaldehyde (I) or to a styrene–divinylbenzene copolymer (II) were evaluated from a static and a dynamic point of view. The two types of ion exchanger have proved to have practically identical properties, given by the reactivity of isonitrosoacetanilide. The high selectivity of the ion exchangers for Pd^{2+} was utilized to separate palladium in its dilute solutions from an excess of ordinary metals and silver. The exchange capacities for both types of ion exchanger were determined for several cations, including UO_2^{2+}. (auth)

45284 SELECTIVE EXTRACTION OF GALLIUM WITH N-BENZYLANILINE IN CHLOROFORM FROM HYDROCHLORIC ACID MEDIA. Khosla, M. M. L. (Defence Lab., Jodhpur, India); Rao, S. P. Anal. Chim. Acta; 61: No. 1, 156-8(Aug 1972).

N-benzylaniline in chloroform is reported as a new extractant for gallium from hydrochloric acid media. Gallium(III) is readily and quantitatively extracted from 6.5 to 7.5M hydrochloric acid; the phase separation is rapid, and gallium can be easily stripped from the organic phase with water and determined by EDTA titration. The extraction is highly selective if thioglycollic acid is added as masking agent. (D.H.M.)

45285 CHEMISTRY OF GALLIUM [1–5]. PART VI. SEPARATION OF GALLIUM FROM FOREIGN ELEMENTS. Rafaeloff, R. (Soreq Nuclear Research Centre, Yavne, Israel). Radiochim. Acta; 17: No. 2, 113-14(Jul 1972).

Methyl isobutyl ketone was used for the separation of gallium(III) from Al, Sc, Y, La, Eu(III), Tm, Dy, Ge(IV), Cu(II) and Fe(III). The effect of acid concentration, gallium concentration and foreign elements was studied. The gallium can be quantitatively stripped from the organic phase by washing with small quantities of water. (auth)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts: 54310 and 45311.

Chemical and Physico-chemical Properties

Refer also to abstracts: 45259, 45353, 45388, 45417, 45606, and 45978.

45286 (MLM–1913) CARBON-13: A SELECTED ABSTRACT BIBLIOGRAPHY. Stringham, W. S. (comp.) (Mound Lab., Miamisburg, Ohio). 15 May 1972. Contract AT(33-1)-Gen-53. 205p. Dep. NTIS.

A listing of 627 selected references and abstracts is presented of chemical and physical properties, analytical and production methods, and uses of carbon-13. The abstracts are listed chronologically and numbered serially for each year from 1962 through 1971. An authors index and key word index are included. (auth)

45287 (SC-R–722769) FUSED SALTS. A Bibliography. VOLUME I. CITATIONS LISTING. VOLUME II. SUBJECT/TITLE INDEX. VOLUME III. AUTHORS INDEX. Clark, Paul V. (comp.) (Sandia Labs., Albuquerque, N. Mex.). Jun 1972. 1149p. Dep. NTIS $12.00.

These Volumes are issued separately, but cataloged as a unit.

This publication incorporates the bibliographic data published in SC-R-68-1680 (Fused Salt Mixtures: Eutectic Compositions and Melting Points); SC-R-69-1386 (Fused Salt Mixtures: Specific Conductivity Tables); and, through reference number 6373 of SC-R-71-3315 (Fused Salts, A Bibliography). It is provided to furnish supplementary access points (subject terms and title words) not available in the original publications. (auth)

45288 (TID–26106) CHEMISTRY OF HTGR. de Nordwall, H. J. (Oak Ridge National Lab., Tenn.). 1972. 44p. Dep. NTIS.

Chemical problems associated with the HTGR include: control of helium purity, boiler deposits, evaluation, fuel studies, fission product studies, and coolant studies. These problems are discussed using tables and graphs. (M.C.G.)

45289 METHOD OF PREPARING SECONDARY ALKALINE AMINE DERIVATIVES. Lambert, Irma; Ravoire, Jean (to Commissariat a l'Energie Atomique). French Patent 2,088,610. 13 Dec 1971. Filed 17 Apr 1970. (In French).

A method for preparing alkaline derivatives of secondary amines having an RR'NM formula (R and R' are aliphatic radicals with between 1 and 6 carbon atoms and M is an alkali metal, i.e., Li, Na, K, Rb, or Cs) is described. The method consists of reacting an amine having an RR'NH formula with an alkaline amide, MNH_2, in suspension in the amine solution. The suspension is obtained by adding the amine to the alkaline amide in ammonia. These secondary alkaline amine derivatives are used as catalysts in isotopic exchange reactions between the corresponding amines and hydrogen. (France)

45290 ORGANIC DISULFIDES AND RELATED SUBSTANCES. 33. SODIUM 4-(2-ACETAMIDOETHYLDITHIO)BUTANESULFINATE AND RELATED COMPOUNDS AS ANTIRADIATION DRUGS. Field, Lamar; Khim, Yong H. (Vanderbilt Univ., Nashville). J. Med. Chem.; 15: No. 3, 312-15(Mar 1972).

The compound $AcNH(CH_2)_2SS(CH_2)_4SO_2Na$ (1), a promising antiradiation drug, disproportionates far more rapidly in solution to the symmetrical disulfides 2 (the amide) and 3 (the sulfinate) than would be expected from behavior of analogous compounds having no SO_2Na moiety; solid 1 is stable. The disproportionation is reversible. An improved preparation of 1 minimizes disproportionation by use of lower temperatures, precipitation instead of concentration, and minimum contact with polar solvents. Radioprotective activity of an improved 1 confirms earlier results; 3 is active as well, but 2 is inactive. The trisulfide $[NaO_2S(CH_2)_4S]_2S$ (9) was prepared in 80% yield from 1,2-dithiane 1,1-dioxide (6) using Na_2S. Thus far, 9 has shown ALD_{50} > 900 mg/kg (ip or po) and 73 to 100% protection of mice at doses of 38 (ip)-300 (po) mg/kg in mice. The promising activity of 3 and (especially) 9 is noteworthy since neither contains a nitrogen function. (auth)

Isotope Effects

Refer also to abstracts: 45342 and 45343.

45291 MICROWAVE SPECTRUM, STRUCTURE, AND DIPOLE MOMENT OF ETHYLENE SULFONE. Kim, Hyunyong (Univ. of Missouri, Columbia). J. Chem. Phys.; 57: No. 3, 1075-7(1 Aug 1972).

The microwave rotational spectra of the ^{32}S and ^{34}S isotopic species of ethylene sulfone were observed. The rotational constants A, B, and C in megahertz are: 6676.06, 4924.01 and 3759.97 for the ^{32}S species; and 6679.20, 4917.07, and 3757.64 for the ^{34}S species. The structural parameters obtained are r(S−O) = 1.42 ± 0.02 Å, r(C−C) = 1.586 ± 0.01 Å, r(C−S) = 1.76 ± 0.02 Å, and ∠OSO = 124 ± 2°, with the assumption that the C−H distance and ∠HCH and $\angle H_2CC$ angles are the same as those of ethylene sulfide. From the measurements of Stark shifts, the dipole moment was determined to be 4.47 ± 0.02 D. (auth)

45292 SOLVENT DEUTERIUM ISOTOPE EFFECTS IN ACID-BASE REACTIONS. VII. SEPARATION OF THE OVERALL ISOTOPE EFFECT IN THE DISSOCIATION OF PICRIC ACID INTO TRANSFER AND ISOTOPE EXCHANGE EFFECTS. Salomaa, Pentti (Univ. of Turku, Finland). Suomen. Kem.; 45: No. 5-6, 149-54(1972).

Changes in standard free energies were measured for the transfer of protopicric acid from benzene to light water, the transfer of deuteropicric acid from benzene to heavy water, and the transfer of 1, 3, 5-trinitrobenzene from light to heavy water. On the basis of two assumptions, the validities of which were tested by comparison with experimental data, the results allow calculation of the relative acid strengths of picric acid in light and heavy water. When the present results were combined with other thermodynamic data, the overall isotope effect on the pK value of picric acid can be divided into its constituent parts, namely, effect involved in the transfer of the light isotope species from light to heavy water and isotope exchange effects associated with replacements of protium by deuterium in these species. The contribution of the former effects is about 20% of the overall effect. (auth) (Finland)

45293 ISOTOPE EFFECT ON FRANCK−CONDON FACTORS AND r-CENTROIDS FOR THE NEW ($^1\Sigma_\mu^+$−$^1\Sigma_g^+$) SYSTEM OF ISOTOPIC C_2 MOLECULE. Singh, I. D.; Maheshwari, R. C. (Univ. of Gorakhpur, India). Indian J. Pure Appl. Phys.; 9: No. 5, 296-7(May 1971).

A partial array of Franck−Condon factors and r-centroids was computed based on a Morse model for the bands of $^{12}C_2$ and $^{13}C_2$ molecules of astrophysical importance, observed and analyzed by G. Herzberg and A. Lagerqvist [Can. J. Phys., 46 (1968), 2363]. The ratio of Franck−Condon factors for $^{12}C_2$ and $^{13}C_2$ molecules is greater than unity for the $\Delta\nu = 0$ sequence and decreases with transitions to higher levels in both the ν' and ν'' progressions. The isotopic effect on r-centroids is small but significant. (auth)

45294 TEMPERATURE DEPENDENCE OF THE ISOTOPE EFFECT FOR ELECTROMIGRATION OF RUBIDIUM IONS IN MOLTEN RUBIDIUM NITRATE. Lunden, Arnold; Floberg, Allan; Mattsson, Ronny (Chalmers Inst. of Tech., Goteborg). Z. Naturforsch.; 27a: No. 7, 1135-8(Jul 1972).

The relative difference (Δb/b) between the internal electromigration mobilities of ^{85}Rb and ^{87}Rb in molten $RbNO_3$ was measured over the range 355 to 500°C. The mass effect $\mu = (\Delta b/b)/(\Delta m/m)$ has a complicated temperature dependence. Thus, the largest mass effect, $-\mu = 0.061$, was obtained at 445°C, while it is about 0.033 at 350°C and 0.041 at 500°C. A similar temperature dependence was found by Saito et al. for μ_{Na} in pure $NaNO_3$, and for both μ_{Rb} and μ_{Na} maxima were found also in nitrate mixtures (in KNO_3-RbNO_3 and $NaNO_3-KNO_3$). (auth)

45295 DECAY TIMES, INTENSITIES, AND THEIR TEMPERATURE VARIATION OF LUMINESCENCE OF AQUEOUS AND DEUTERATED SOLUTIONS OF EUROPIC ION. Pant, D. D.; Bhatt, B. C.; Sanwal, D. N. (Th. D. S. B. Government Coll., Naini Tal, India). Indian J. Pure Appl. Phys.; 9: No. 5, 324-6 (May 1971).

Because of the contradicting nature of the results reported by J. L. Kropp and M. W. Windsor [J. chem. Phys., 39 (1963), 2769; 42 (1965), 1599] and P. K. Gallagher [J. chem. Phys., 43 (1965), 1742] in their studies on luminescence of Eu^{3+} ions in water and heavy water solutions, a careful study of the decay times and relative intensities was made. The results of the present study are in disagreement with the results reported by Gallagher. The temperature variation of decay times and relative intensities in the range 80 to 300°K shows a λ-type behavior for the solutions in D_2O-H_2O mixtures. The temperature variation characteristics are explained on the basis of the diffusion of H^+ and OH^- ions. The dependence of decay times and intensities on H_2O concentration indicates the Stern−Volmer mechanism of quenching. The various processes involved in the mechanism of quenching are discussed. (auth)

45296 ESR EVIDENCE FOR THE INFLUENCE OF ETHANOL ON THE HYDRATED COMPLEXES OF COPPER IONS. Znamirovschi, V.; Cozar, O. (Univ., Cluj). Acta Phys. Pol.; A42: No. 1, 3-7(Jul 1972).

An ESR study was performed on the steric effect of ethanol molecules on the first hydration shell of copper ions. The resolution of the hyperfine structure increases with the ethanol concentration. An H−D isotope effect, which appears in the hyperfine structure, is mentioned and is explained by the preferential association of the ethanol with H_2O. (auth)

45297 NUCLEAR MAGNETIC RELAXATION STUDY OF FORMIC ACID. ISOTOPE EFFECT AND ^{13}C RELAXATION. Ozawa, Hiroshi; Arata, Yoji; Fujiwara, Shizuo (Tokyo Univ.). J. Chem. Phys.; 57: No. 4, 1613-15(15 Aug 1972).

The transient recovery after adiabatic inversion was observed separately for the magnetizations of the $^{12}C-H$, $^{13}C-H$, and O−H protons of formic acid. A large difference was observed between the decay constants for the $^{12}C-H$ and $^{13}C-H$ protons. It was concluded that this difference is due to (1) flip of the ^{13}C spin resulting in an exchange of the two $^{13}C-H$ proton signals, and (2) intramolecular dipolar coupling between the ^1H and ^{13}C spins. The above results were used along with the nuclear Overhauser effect data to estimate the ^{13}C spin-lattice relaxation time. It was also shown that the difference in relaxation times between the $^{12}C-H$ and $^{13}C-H$ protons is primarily due to the intramolecular dipolar coupling between the ^1H and ^{13}C spins. (auth)

45298 QUENCHING OF INFRARED CHEMILUMINESCENCE: RATES OF ENERGY TRANSFER FROM HF ($\nu \leq 5$) TO CO_2 AND HF, AND FROM DF ($\nu \leq 3$) TO CO_2 AND HF. Airey, J. R. (Naval Research Lab., Washington, D. C.); Smith, I. W. M. J. Chem. Phys.; 57: No. 4, 1669-76(15 Aug 1972).

The intensity of HF (and DF) infrared chemiluminescence from vibrationally excited molecules produced in the chain reaction $H + F_2 \rightarrow HF + F$; $F + H_2 \rightarrow HF + H$ (and its deuterium analogue) was studied as a function of the concentration of added CO_2 and HF. Using a steady-state analysis, rate coefficients were determined for transfer of vibrational energy from HF ($\nu \leq 5$) and DF ($\nu \leq 3$) to (vibrationally cold) CO_2 and HF. The results are discussed in terms of possible mechanisms for energy transfer and the importance of the processes in chemical lasers. (auth)

45299 APPLICATION OF PERTURBATION THEORY FOR THE CALCULATION OF MOLECULAR CONSTANTS DUE TO SMALL MASS CHANGES AND ON THE DETERMINATION OF FORCE CONSTANTS FROM VERY HEAVY ISOTOPE SUBSTITUTION. Mueller, A.; Schmidt, K. H.; Mohan, N. (Univ., Dortmund, Ger.). J. Chem. Phys.; 57: No. 4, 1752-7(15 Aug 1972).

The first-order perturbation theory was used to develop the expressions for studying the mass effect on Coriolis coupling constants in isotopically substituted molecules. The corresponding treatment reported by Wilson, Decius, and Cross for the calculation of isotopic frequency shifts has been applied to a large number of molecules with heavy and very heavy atom isotopic substitution, for which the experimental data were published in recent years. The use of a simple method (L matrix approximation) for the calculation of isotope shifts in molecules with small mass coupling, from the knowledge of the geometrical parameters only, is suggested. The results obtained using the perturbation theory for the calculation of $\Delta\nu$ and $\Delta\zeta$ are found to be quite encouraging. An outline of the utility of data on very heavy isotopic substitution for the determination of force constants is given with illustrative examples. (auth)

45300 ISOTOPE EFFECTS IN THE BARTON REACTION. Ferguson, Robert Nicholas. Baltimore; Johns Hopkins Univ. (1971). 346p. University Microfilms Order No. 72-16,912. Thesis.

The primary deuterium isotope effect for hydrogen abstraction in the photolysis of the nitrites of the epimeric alcohols at carbon-11 in apollane (1,4,4,7-tetramethyl tricyclo[5.3.1.$0^{2,6}$]undecane) was determined. Both of these nitrites give the same oximino alcohol on photolysis. The isotope effect served both as a probe of the transition state for hydrogen abstraction in this photolysis and as a method of comparison of the alkoxy radicals derived from each of the epimeric nitrites. A nondeuterated olefin alcohol was also prepared and reduced with dideutero diimide to give a 2,3α-dideuterated alcohol. Photolysis of this nitrite gave a surprising secondary isotope effect of 1.7. The data indicate that most of this effect is due to only one (3α) of the two deuteriums. The corresponding epimeric tertiary alcohols structures 10 and 11 were prepared and these two nitrites upon photolysis gave the same photo oximino alcohol. The corresponding 3β-deuterated tertiary nitrites of these alcohols were prepared and photolyzed and the isotope effect was found to be ca. 1.1 for each epimer. This value is much lower than that found for the secondary apollanols. The results with the secondary and tertiary systems indicate that the epimerized alkoxy radical has a very similar selectivity to the alkoxy radical generated immediately upon photolysis, and that this is not an "activated" alkoxy radical. The marked difference in primary isotope effects between the secondary and tertiary systems leads to the conclusion that considerable variation is possible in the

exact geometry and extent of hydrogen transfer in the transition state for intramolecular alkoxy radical hydrogen abstraction. (Diss. Abstr. Int., B)

45301 ISOTOPE EFFECTS UPON KINETIC ENERGY RELEASE IN METASTABLE ION FRAGMENTATIONS. Bertrand, M.; Beynon, J. H.; Cooks, R. G. (Purdue Univ., Lafayette, Ind.). J. Mass Spectrom. Ion Phys.; 9: No. 3, 346-50(Aug 1972).

Values of T_H/T_D, were T is the kinetic energy released in unimolecular ionic reactions, were measured for H' loss from a number of metastable molecular ions. It is suggested that H' loss should give $T_H/T_D \approx 1$ and only if special factors intervene does this value deviate appreciably from unity. Experimental data are in accord with this postulate. (M.C.G.)

Isotope Exchange and Isotope Separation

45302 (COO-1222-55) TECHNICAL PROGRESS REPORT ON FUNDAMENTAL STUDIES OF SEPARATION PROCESSES. Rogers, L. B. (Purdue Univ., Lafayette, Ind. Dept. of Chemistry). Jul 1972. Contract AT(11-1)-1222. 19p. Dep. NTIS.

Progress was made in three different major areas. Using high-precision gas chromatography, a mathematical technique, principal component analysis, was shown to be a promising means for analyzing chromatographic peak shapes. A study of electrostatic effects on gas chromatograms obtained using liquid-crystal stationary phases appears to have uncovered a new type of diffusion-limited phenomenon. Studies of micellar and ion-exchange equilibria were shown to be feasible, using gels as column packings, at pressures up to 50,000 psi. Using a relatively inexpensive quadrupole mass spectrometer as a detector for a gas chromatograph, enrichment of the $^{13}C/^{12}C$ ratio in carbon dioxide, after passage through a short column of silica, was confirmed. Currently, the enrichment is being examined under different conditions in the hope of achieving a sufficient separation to allow analyses to be made without using a mass spectrometer. (auth)

45303 IDENTIFICATION OF REACTION INTERMEDIATES BY MICROWAVE SPECTROSCOPY. THE CATALYTIC REACTIONS BETWEEN PROPYLENE AND DEUTERIUM OVER ZINC OXIDE. Naito, Shuichi (Sagami Chemical Research Center, Sagamihara, Japan); Kondo, Toshikiko; Ichikawa, Masaru; Tamaru, Kenzi. J. Phys. Chem.; 76: No. 15, 2184-5(20 Jul 1972).

The identification of the reaction intermediate in the propylene–deuterium exchange reaction over zinc oxide is reported and the mechanism of the deuterium addition to propylene is also discussed. The deuterium distribution of the product propylene-d_1 suggested that the reaction intermediate of the propylene–deuterium exchange reaction was a π-allyl species. However since propane-d_2 was formed predominantly from the beginning of the reaction, it was concluded that propane-d_2 is formed by the simple addition of deuterium to the double bond of normal propylene or to the propyl group in the surface. It was concluded that hydrogenation and isomerization proceed through different reaction intermediates over zinc oxide. (D.H.M.)

45304 IRON(II) AND IRON(III) ISOTOPE EXCHANGE IN WATER–DIMETHYL SULFOXIDE MIXTURES. Henry, Marian S.; Reynolds, Warren L. (Univ. of Minnesota, Minneapolis). Int. J. Chem. Kinet.; 4: No. 1, 37-48(Jan 1972).

The rate of the isotope exchange reaction between iron(II) and iron(III) perchlorates was measured in a solvent mixture containing a 3:2 mole ratio of water to dimethyl sulfoxide over the temperature range from 25 to −98°C. In this temperature range, the reactants can diffuse together faster than they can undergo isotope exchange. The activation enthalpy and entropy for the acid-independent reaction were 6.0 ± 1.2 kcal/mole and −38 ± 17 cal/deg mole, respectively. Below −22°C, the acid-dependent exchange reaction did not contribute significantly to the exchange. In liquid media at −112 and −117°C and in a solid glass at −136°C, no isotope exchange was observed over the period of a calculated half-life for the reaction. At these temperatures, the rate at which the reactants diffuse together is slower than the calculated rate of isotope exchange. In a solid glass at −196°C, no isotope exchange was observed over the period of one week. (auth)

45305 HYDROGEN–DEUTERIUM EXCHANGE KINETICS OF CYTOCHROME C BETWEEN 20 AND 38°C. Nabedryk-Viala, Eliane; Mestelan-Nonnenmacher, Genevieve; Calvet, Paul (CEN de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. D; 274: No. 9, 1414-17(28 Feb 1972). (In French).

The hydrogen–deuterium exchange kinetics of ferricytochrome c (taken from the heart of a horse) were studied at a pH of 7 and at temperatures between 20 and 38°C. Increasing the temperature increased the rate of exchange between the hydrogen atoms and diminished the number of nonexchanged hydrogen atoms in a 24-hr period from 40 to 28. (France)

45306 STUDY OF EXCHANGE REACTIONS EMPLOYING A COMPLEMENTARY SHOCK TUBE FACILITY. Nika, G. Gerald. New Orleans; Louisiana State Univ. (1971). 210p. University Microfilms Order No. 72-20,803.

Thesis.

A complementary shock tube facility was constructed, employing time-of-flight mass spectrometry and infrared emission spectroscopy as analytical tools. The purpose of this facility is to study homogeneous, high-temperature gas phase exchange reactions, principally the isotopic exchange reaction $H_2 + D_2 = 2$ HD. This system is the prototype for other isotopic exchanges and has received considerable theoretical and experimental attention. Bauer's single-pulse shock tube study of this reaction led to the proposal of a vibrational energy mechanism since molecular or atomic mechanisms cannot explain the experimental data. It is demonstrated that molecular or atomic mechanisms are at variance with experimental observations and the acceptability of the energy mechanism is argued against. Three exchange reactions were studied; HCl + D_2, H_2 + D_2, and the self-exchange of HD. The first system was investigated using the complementary facility to demonstrate the validity of the time-of-flight-shock tube apparatus. This study covered the temperature range 1700 to 2800°K and the results from the time-of-flight and infrared emission shock tubes agree within one standard deviation for the Arrhenius parameters. A non-linear growth of product mole fraction was determined by the two sets of experiments. The combined data is given by the equation $(1 - f_{DCl}[1 + (f_{HCl}/f_{DCl})_{eq}]) = \exp(-k[M]t^2)$ where, $k = 10^{16.12\pm0.30} \exp(-34{,}340 \pm 3{,}130/RT)$, cm^3/mol sec^2. The H_2 + D_2 exchange reaction and the self-exchange of HD were studied only on the time-of-flight-shock tube. For the forward reaction the temperature range was 1800 to 3000°K, for the reverse reaction 1800 to 2800°K. Deuterium hydride mole fraction exhibited a nonlinear time dependent growth and is given by the rate expression $[1 - 2f_{HD}] = \exp(-k[M]t^2)$ where, $k = 10^{16.93\pm0.24} \exp(-44{,}370 \pm 2{,}510/RT)$, cm^3/mol sec^2. The data obtained from the HD self-exchange supports a nonlinear time dependent growth of H_2 and D_2 mole fractions. Using an average mole fraction basis the reaction profile for the back reaction is $[1 - 4f_{av}] = \exp(-k^1[M]t^2)$ where, $k^1 = 10^{16.67\pm0.21} \exp(-40{,}980 \pm 2{,}250/RT)$, cm^3/mol sec^2. All reaction systems are sufficiently described by a quadratic time dependence for product formation. Experimental activation energies are low with respect to values predicted by molecular or atomic mechanisms. The quadratic time dependence and inert gas dependence rule out a four-center mechanism, while a vibrational energy sequence is ruled out by the non-linear time dependence of product formation. An atomic mechanism supports the quadratic time dependence but fails to predict the observed activation energy or total reaction order. (Diss. Abstr. Int., B)

45307 ISOTOPIC SEPARATION BY PHOTOPREDISSOCIATION. Yeung, Edward S.; Moore, C. Bradley (Univ. of California, Berkeley). Appl. Phys. Lett.; 21: No. 3, 109-10(1 Aug 1972).

A monochromatic source may be used to excite individual isotopic lines in a well-resolved absorption spectrum for which the upper state is predissociated. Isotopic enrichment is thus achieved in the dissociation products, which may be stable molecules or may be chemically trapped if they are reactive. As an example, isotopic separation of hydrogen and deuterium is performed by exciting formaldehyde with a frequency-doubled ruby laser. (auth)

Feed Materials Processing

Refer also to abstracts: 45389, 45390, 45405, and 46080.

45308 (DOCKET-701327-1) URANIUM HEXAFLUORIDE FACILITY. Environmental Report. (Allied-Gulf Nuclear Services, Barnwell, S. C.). 30 Jun 1972. 538p. Dep. NTIS.

Information is submitted in support of an application for license to possess and use special nuclear material, source material, and by-products material associated with the conversion of uranyl nitrate to UF_6. The effects on the environment of the construction and operation of the facility are described. A description is given of the natural resource usage and disposition of radioactive, chemical, and sanitary waste. The site, plant, environmental effects of site preparation and plant construction, environmental effects of plant operation, accidents, alternatives to plant construction and operation, and costs and benefits are discussed. The independently managed environmental monitoring program, the impacts of liquid discharges on Lower Three Runs Creek, transportation requirements associated with UF_6 facilities, and a literature survey concerning environmental effects of several fluoride-associated compounds that are used in the UF_6 facility are given in the Appendixes. (M.C.G.)

Radiation Chemistry

Refer also to abstracts: 45632, 45672, and 46084.

45309 (AE-453) NUCLEAR CHEMISTRY. Progress Report, 1971. (Aktiebolaget Atomenergi, Studsvik (Sweden)). 1972. 21p. Dep. NTIS (U. S. Sales Only).

ANILINE—radiolysis of aqueous solutions of pure and substituted, yield of cyclohexadienyl-type radical from pulse
BENZYL (FREE RADICAL)—spectra of, produced by pulse radiolysis of aqueous acid toluene solutions
CARBON—determination in stainless steel and Zircaloy by deuteron and proton activation
ELECTRONS—effects of pulsed, on ice and ice-d_2, optical absorption spectra of transient electrons from
ICE—radiolysis of, optical absorption spectra of transient electrons from pulse
ICE-d_2—radiolysis of, optical absorption spectra of transient electrons from pulse
IODINE-125—purification of trace amounts of, by water vapor distillation in oxidizing atmosphere
OXYGEN—determination in stainless steel and Zircaloy by deuteron and proton activation
STAINLESS STEEL—analysis for carbon and oxygen by deuteron and proton activation
TOLUENE—radiolysis of aqueous acid solutions of, spectra of benzyl radicals from pulse
ZIRCALOY—analysis for carbon and oxygen by deuteron and proton activation (P.C.H.)

45310 (BARC-595) WATER CHEMISTRY STUDIES VII: A GENERAL REVIEW OF WATER CONDITIONS AND WATER TREATMENT IN NUCLEAR REACTORS. Mathur, P. K.; Venkateswarlu, K. S. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 36p. Dep. NTIS (U. S. Sales Only).

A general review is presented covering the problems of water conditions in water-moderated and -cooled nuclear reactors of different types, viz., pool and tank reactors, PWR's and BWR's. The different sources of impurities in the reactor water, its stringent specifications, and the degradation by corrosion, radiolysis, etc., are discussed. The methods and the equipment used in purification, e.g., ion exchange, filtration and degasification, are discussed in detail. Uses of additives to control pH in the coolant, as poisons for emergency shutdown and shim purposes, and for scavenging dissolved oxygen in the coolant are also discussed. (auth)

45311 (BARC-599) CHEMISTRY DIVISION ANNUAL REPORT, 1970-1971. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 163p. Dep. NTIS (U. S. Sales Only).

Research progress is reported in three areas: preparation of pure materials, radiation chemistry, and solid-state studies. References to published papers are given. (M.C.G.)

45312 (COO-2147-2) PREPARATION AND CHARACTERIZATION OF BIOCOMPATIBLE POLYMERS BY RADIATION GRAFTING AND RADIOISOTOPE TECHNIQUE. Technical Progress Report, June 15, 1971-May 15, 1972. Andrade, J. D. (Utah Univ., Salt Lake City. Div. of Materials Science and Engineering). May 1972. Contract AT(11-1)-2147. 25p. Dep. NTIS.

Grafted gel surfaces for medical applications were prepared by γ-induced grafting of hydroxyethyl methacrylate (HEMA) and other hydroxyalkyl methacrylates on inert polymer substrates. Data on wetting and wettability of the grafted gel surfaces were obtained. Protein adsorption by the gel interfaces was studied. (M.C.G.)

45313 (COO-3029-1) ANNUAL PROGRESS REPORT, JUNE 1, 1971-MAY 31, 1972. Turkevich, John (Princeton Univ., N. J.). 1972. Contract AT(11-1)-3029. 6p. Dep. NTIS.

Studies carried out included: radiocolloids, radiation effects on ferrocene adsorbed on glass, and production of hydrogen. (M.C.G.)

45314 (COO-3286-1) RADIATION CHEMISTRY OF NUCLEIC ACIDS. ISOLATION AND CHARACTERIZATION OF THYMINE GLYCOLS. Hahn, Bo-Sup; Wang, Shih Yi (Johns Hopkins Univ., Baltimore, Md. Dept. of Biochemistry). [1971]. Contract AT(11-1)-3286. 7p. Dep. NTIS.

Dihydroxydihydrothymine was identified in irradiated aqueous solutions of thymine and the chemistry of the cis and trans configurations studied. (M.C.G.)

45315 (COO-3286-3) CHEMICAL STUDY OF THE EFFECTS OF RADIATION ON NUCLEIC ACIDS AND RELATED COMPOUNDS. Three Year Progress Report, June 1969-May 1972. Wang, Shih Y. (Johns Hopkins Univ., Baltimore, Md. Dept. of Biochemistry). May 1972. Contract AT(11-1)-3286. 10p. Dep. NTIS.

The chemical natures of radioinduced damage to nucleic acids and their components were studied. Isolation and characterization of thymine glycols and a thymine hydroperoxide, chemical synthesis of radiation products of thymine, and the effects of thymine hydroperoxide on chemical compounds, transforming DNA, and chromosomes are discussed. (M.C.G.)

45316 (ORO-3909-3) SYNTHESIS, IDENTIFICATION, AND PURIFICATION OF C_6 AND C_7 FLUOROCARBONS FROM RADIOLYSIS. Final Report. Askew, W. C.; Ward, C. H.; Hardie, F. W.; Parker, B. R.; Maduskar, K. D. (Auburn Univ., Ala. Dept. of Chemical Engineering). Dec 1971. Contract AT(40-1)-3909. 84p. Dep. NTIS.

Synthesis of appreciable amounts of large-molecular-weight fluorocarbons from CF_4 and C_2F_6 by ^{60}Co γ rays using flow and batch reactors with and without granular carbon has not been feasible although small amounts of large molecular weight fluorocarbons were made. A new reaction mechanism involving abstraction reactions has been proposed for the radiolysis of saturated fluorocarbons. ^{19}F NMR spectroscopy can be used for the identification of separated fractions of perfluoroalkanes. Branched chain perfluoroalkane isomers can be easily differentiated from the corresponding n-perfluoroalkane and differentiation among the various isomers is also possible. Semiquantitative analysis of mixtures is feasible if a given component is present in amounts greater than about 10%. Gas chromatographic methods are presented for qualitative and quantitative analysis of perfluoroalkanes. (auth)

45317 ESR STUDIES OF ELECTRON IRRADIATED $K_3Ir^{III}(CN)_6$ IN KCl SINGLE CRYSTALS. I. LIGAND HYPERFINE STRUCTURE IN $Ir^{II}(CN)_5$ SPECIES. Vugman, N. V.; Muniz, R. P. A.; Danon, J. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). J. Chem. Phys.; 57: No. 3, 1297-1300(1 Aug 1972).

Electron irradiation of the diamagnetic $[Ir(CN)_6]^{3-}$ ion in a KCl host lattice produces two paramagnetic species. ESR studies reveal that one of the species can be assigned to the pentacoordinated $[Ir(CN)_5]^{3-}$, of approximate C_{4v} symmetry, with $5d^7$ low spin configuration, arising from the trapping of an electron in a d_{z^2} orbital followed by the loss of an axial cyanide. Ligand hyperfine structure with four equivalent and one nonequivalent nitrogens is observed and confirmed by isotopic substitution. The g values and the ligand hyperfine tensors are presented and discussed. Ligand f_s and f_p spins densities are calculated and discussed. (auth)

45318 RADIATION-INDUCED COPOLYMERIZATION OF VINYLPHOSPHONIC DICHLORIDE WITH METHYL METHACRYLATE AND STYRENE. Fujii, Shigetada; Maeda, Katsuaki (Government Industrial Research Inst., Nagoya, Japan). J. Appl. Polym. Sci.; 16: No. 6, 1331-8(Jun 1972).

The γ-induced copolymerization of vinylphosphonic dichloride (VPDC) with methyl methacrylate (MMA) and styrene (St) was studied at 25°C (liquid phase) and −78°C (solid phase). The reaction mechanisms are discussed. The reactivity ratios for the copolymerization of the VPDC−MMA system were determined as follows: 25°C: $r_1 = 0.084$, $r_2 = 6.6$ and −78°C: $r_1 = 0.081$, $r_2 = 2.1$. The difference between the reactivity between the liquid-phase (25°C) and solid-phase (−78°C) copolymerization is mainly attributable to the r_2 value. The behavior of the liquid-phase copolymerization of the VPDC−St system was anomalous, the r_1 value being negative in the range from 0 to 80 mole-% of VPDC monomer. In the solid-phase (−78°C) copolymerization for the VPDC−St system, the reactivity ratios r_1 and r_2 were 0.097 and 1.6, respectively. The rate of copolymerization (R_p) at 25°C, for both the VPDC−MMA and VPDC−St systems, passes a maximum point at a certain monomer concentration, suggesting that the composition of copolymer is considerably affected by R_p. This phenomenon was interpreted by the assumption that an energy transfer reaction from VPDC monomer to the other vinyl compound can easily occur. (auth)

45319 TRAPPED ELECTRONS PRODUCED IN ETHANOL GLASS AT 4°K. Hase, Hirotomo; Warashina, Tetsuo; Noda, Masato; Namiki, Akira; Higashimura, Takenobu (Kyoto Univ.). J. Chem. Phys.; 57: No. 3, 1039-45(1 Aug 1972).

Optical absorption and ESR measurements were carried out on e_t^- produced in ethanol at 4°K. The same e_t^- yield for γ radiolysis at 4 and 77°K indicates that electrons are stabilized in pre-existing traps at 4°K where molecular dipoles remain unrelaxed. e_t^- prior to solvation can be classified into two groups. One with $\lambda_{max} = 1500$ nm, $W_{\frac{1}{2}} = 4 \times 10^3$ cm^{-1} and $\Delta H_{pp} = 5.5 \pm 0.5$ G is easily photobleached by the infrared light. The other with broad absorption band in the visible and $\Delta H_{pp} = 13.5 \pm 1.5$ G is not photobleached by the infrared light. The successive shift of the absorption spectrum to the higher energy side on warming is interpreted by the molecular reorientation mechanism. e_t^- decay is observed during the solvation process, depending on time required for the solvation. The blue shift of the absorption spectrum on reducing the temperature is attributed to contraction of electron traps. (auth)

45320 RADIATION-INDUCED GRAFT COPOLYMERIZATION OF MIXTURES OF STYRENE AND n-BUTYL ACRYLATE ONTO CELLULOSE AND CELLULOSE TRIACETATE. Matsuzaki, Kei; Nakamura, Shigeo; Shindo, Shuichi (Tokyo Univ.). J. Appl. Polym. Sci.; 16: No. 6, 1339-55(Jun 1972).

Mixtures of styrene and n-butyl acrylate of various compositions were grafted onto cellulose and cellulose triacetate fibers preirradiated with γ rays at 0°C in air. Monomer reactivity ratios of the grafted copolymers were found to be different from those of the nongrafted copolymers or those of AIBN-initiated copolymers. The active species initiating the graft copolymerization were trapped radicals for cellulose and peroxides for cellulose triacetate. Kinetic investigations of the graft copolymerization of styrene onto preirradiated cellulose triacetate fibers were also carried out, and it was found that the kinetic scheme for radical polymerization is also applicable to graft copolymerization in a heterogeneous system. (auth)

45321 RECOMBINATION PRODUCTS FROM THE RADIOLYSIS OF TRICAPROIN. Letellier, P. R.; Nawar, W. W. (Univ. of Massachusetts, Amherst). J. Amer. Oil Chem. Soc.; 49: No. 4, 259-63(Apr 1972).

A low-molecular-weight triglyceride, tricaproin, was selected to study the higher molecular weight products produced by irradiation. In a previous publication identification of the primary radiolytic products in tricaproin was reported. In the present work, 28 compounds considered to have been produced by the combination of free radicals were identified. Among these are hydrocarbons, ketones, esters, alkanediol diesters, and glyceryl ether diesters. Reaction mechanisms for the production of these compounds are discussed. (auth)

45322 COMPARISON OF THE RADIOLYSIS OF LIQUID BROMOTRIFLUOROMETHANE WITH THE RADIOLYSIS OF LIQUID TRIFLUOROIODOMETHANE. McAlpine, I.; Sutcliffe, H. (Univ. of Salford, Eng.). J. Phys. Chem.; 76: No. 15, 2070-1(20 Jul 1972).

The radiolysis of bromotrifluoromethane in the liquid phase at room temperature was examined. The products and 100 eV yields are: tetrafluoromethane, 0.62; hexafluoroethane, 0.25; dibromodifluoromethane 0.98; and bromine, 0.22. In the presence of iodine the products and some 100-eV yields are: tetrafluoromethane, 0.05; hexafluoroethane, 0.11; trifluoroiodomethane, 3.54; dibromodifluoromethane, and probably bromodifluoroiodomethane. These results are compared with those obtained previously for liquid trifluoroiodomethane. (auth)

45323 ELECTRON SPIN RESONANCE STUDY OF THE FAR-ULTRAVIOLET PHOTOLYSIS OF SOME INORGANIC AND ORGANIC COMPOUNDS. Kuwata, Keiji; Kotake, Yashige; Inada, Koji; Ono, Mitsuo (Osaka Univ.). J. Phys. Chem.; 76: No. 15, 2061-9(20 Jul 1972).

Intermediates in the solid-phase photolysis of alkanes, alcohols, ethers, water, and hydrogen peroxide were investigated at 20 and 77°K. Free-radical intermediates in the vapor-phase photolysis were also examined by a quenching technique at low temperature. In alkanes, alcohols, and ethers formation of ionic species is found when the energy of the far-uv light is higher than the ionization thresholds of these compounds. Also, photolytic conversion of the ionic species into secondary free radicals was examined. Photolytic conversion of the primary free radicals into secondary radicals by successive irradiations with uv light was also studied. In ice and solid hydrogen peroxide photolyzed at low temperature, a singlet spectrum with a line width of ca 13 G was observed. In connection with this system, some other systems were also studied, leading to the assignment of this signal to the HO_3 radical. (auth)

45324 PROTON ENDOR OF γ-IRRADIATED Y-TYPE ZEOLITES. Vedrine, Jacques C.; Hyde, James S.; Leniart, Daniel S. (Varian Associates, Palo Alto, Calif.). J. Phys. Chem.; 76: No. 15, 2087-97(20 Jul 1972).

The initial application of electron–nuclear double resonance (ENDOR) to zeolites is presented and is concerned to a large degree with methodology. Hydrogen atoms are trapped during γ irradiation and the interactions between the atoms and surrounding protons are measured by ENDOR. Motion of the hydrogen atom modulates the dipolar interaction, causing nuclear relaxation of the protons which determines the nature of the ENDOR response. Well-resolved lines have been observed in H–Y-type zeolites. In this system it was determined that the hydrogen atom is trapped in the center of the sodalite cage, and interactions with four different kinds of protons have been found. Sample treatment cycles found to be reversible using other methods were found to be irreversible using ENDOR spectroscopy. (auth)

45325 RADIATION-INDUCED POLYMERIZATION. I. A PYROTECHNIC BINDER. Biggs, William T. (Naval Ammunition Depot, Crane, Ind.); Parrish, C. F. J. Appl. Polym. Sci.; 16: No. 7, 1779-89(Jul 1972).

In the past, binder systems had to be limited to systems where the catalytically initiated polymerization exotherm was low. With radiation-initiated polymerization, this is not a problem, and the number of monomers which can now be investigated is unlimited. Based on the styrene–benzoyl peroxide system, addition of peroxide sensitizers significantly decrease the radiation dose required for 100% conversion. (auth)

45326 I. RADIATION CHEMISTRY OF n-BUTYROPHENONE IN BENZENE SOLUTION. II. RADIATION-INDUCED ALKYLATION OF CAFFEINE BY AMINES. Stankunas, Alexander Robert. Riverside, Calif.; Univ. of California (1971). 140p. University Microfilms Order No. 72-17,048.

Thesis.

The irradiation of benzene solutions of n-butyrophenone leads to the formation of acetophenone and ethylene via a type II process. The G value for this reaction (molecules of product per 100 eV) was found to vary inversely with the dose. It is proposed that the observed decrease in G value is primarily due to the presence of biphenyl, which is produced by irradiation of solvent. An analysis of the rates of various reactions in the system indicate that biphenyl is responsible for at least 80% of the quenching activity. The reactions leading to acetophenone are shown to be strongly dependent on the dose rate. The ethylene produced in the reaction is shown to be unimportant as a quencher of excited butyrophenone. A new reaction, leading to the alkylation of caffeine by amines is reported. The relative reactivity of various alkyl amines under the influence of uv or gamma irradiation is given. Spectral techniques were employed to investigate the possibility of complex formation between the purine and the amines, with generally negative results. Based on data from quenching studies and product structure, a mechanism for the reaction is proposed. Abstraction of a hydrogen atom from the amine by a triplet excited caffeine is followed by radical addition at the 8-position of the caffeine. Loss of ammonia, and final rearrangement to product, follow. In addition, a new radiation-induced reaction between caffeine and acetonitrile to produce a methyl-cyano caffeine is reported. (Diss. Abstr. Int., B)

45327 INVESTIGATION OF THE RADIATION POLYMERIZATION OF METHYL METHACRYLATE–KAOLIN CLAY COMPOSITES. Beeson, James Jackson. Rolla, Mo.; Univ. of Missouri (1972). 156p. University Microfilms Order No. 72-18,182.

Thesis.

A kinetic and characterization study was made on the effects of gamma rays (^{60}Co) on the polymerization of a 50–50 weight mixture methyl methacrylate (MMA)–kaolin clay system. The effect of dose rate (7.35 to 24.9 rads per second), temperature (25 to 75°C), and total dose on the percentage conversion of monomer to polymer was studied. The rate of formation of polymer at 25°C in the composite system was found to be faster when compared to a bulk MMA system at the same experimental conditions. This acceleration showed that the clay had a catalytic effect on the formation of polymer. The effect decreased as temperature increased. Rate data and apparent activation energies are reported. Two types of polymethylmethacrylate (PMMA) were formed in the composite. One type was called homopolymer and could be removed from the composite by extraction with organic solvents. The other type was called inserted polymer and could only be removed by dissolving the clay matrix with hydrofluoric acid. Characterization studies showed that the homo and inserted polymer exhibited the following characteristics: 1. NMR spectra showed that both polymers had increased isotacticity as compared to bulk polymer; 2. the viscosity average molecular weights of the homopolymer ranged from (0.4×10^6 to 5×10^6) depending upon the dose rate, temperature and total dose received; 3. gel permeation chromatography studies confirmed the increase of molecular weight for the homopolymer and showed the same peak molecular weights and distribution for the inserted polymer; 4. infrared spectroscopy showed no differences in the structure of either type of polymer. (Diss. Abstr. Int., B)

45328 RADIATION-INDUCED FORMATION OF EXCITED STATES OF AROMATIC HYDROCARBONS IN BENZENE AND CYCLOHEXANE. II. YIELDS OF EXCITED SINGLET AND TRIPLET STATE SOLUTE MOLECULES. Dainton, Frederick; Morris, T.; Salmon, G. A.; Thompson, G. F. (Univ. of Leeds, Eng. Cookridge Hospital, Leeds, Eng.). Proc. Roy. Soc. (London), Ser. A; 328: No. 1575, 457-79(27 Jun 1972).

The concentration dependences of the yield of excited triplet states, $G(^3S^*)$, and the concentration dependences of the relative yield of radiation-induced fluorescence obtained on pulse radiolysis of solutions of naphthalene, anthracene, pyrene and 2,5-diphenyloxazole (PPO) are reported. The yields of excited singlet state solute molecules, $G(^1S^*)$, formed on pulse radiolysis of

naphthalene–cyclohexane and naphthalene–benzene solutions was determined by comparing the intensity of the radiation-induced fluorescence with that obtained on photo-excitation. It is concluded that intersystem crossing from the excited singlet state is an important process in the formation of the high yield of triplet excited states of the solute. Under certain conditions this process accounts for up to 50% of $G(^3S^*)$ in cyclohexane and the entire $G(^3S^*)$ in benzene solutions. (auth)

45329 RADIATION-INDUCED FORMATION OF EXCITED STATES OF AROMATIC HYDROCARBONS IN BENZENE AND CYCLOHEXANE. III. EFFECT OF SINGLET STATE QUENCHERS. Dainton, Frederick; Morrow, T.; Salmon, G. A.; Thompson, G. F. (Univ. of Leeds, Eng. Cookridge Hospital, Leeds, Eng.). Proc. Roy. Soc. (London), Ser. A; 328: No. 1575, 481-96(27 Jun 1972).

The contribution to naphthalene and pyrene triplet state formation of intersystem crossing from the excited singlet state was determined for both cyclohexane and benzene solutions using the singlet state quenchers nitromethane and xenon. In agreement with conclusions reported previously, intersystem crossing plays an important role; under certain conditions up to 50% of the total triplet yield in naphthalene–cyclohexane solutions has this origin. The extinction coefficient for naphthalene triplet absorption in cyclohexane at $\lambda_{max} = 412.5$ nm is 20,000 ± 5,000 l mol^{-1} cm^{-1}. (auth)

45330 RADIATION-INDUCED FORMATION OF EXCITED STATES OF AROMATIC HYDROCARBONS IN CYCLOHEXANE. IV. EFFECT OF ELECTRON SCAVENGERS. Dainton, Frederick; May, R.; Morrow, T.; Salmon, G. A.; Thompson, G. F. (Univ. of Leeds, Eng. Cookridge Hospital, Leeds, Eng.). Proc. Roy. Soc. (London), Ser. A; 328: No. 1575, 497-513(27 Jun 1972).

The effects of the electron scavengers nitrous oxide, nitromethane, carbon dioxide, sulphur hexafluoride, and chloracetic acid on the yields of naphthalene excited states observed in pulse radiolysis of deaerated naphthalene–cyclohexane solutions were investigated. The excited-state yields were reduced by all the solutes examined although they showed marked differences in their effects on the formation of singlet and triplet excited naphthalene. Of the various competing electron scavengers investigated only the results of the nitromethane system at $[CH_3NO_2] > 10^{-2}$ mol/l could be explained solely in terms of a simple competition for free and geminate ions by the two solutes. However, it was found that the nitrous oxide and carbon dioxide systems could be rationalized on a similar model by taking account of possible secondary ion reactions and/or excited state formation as a result of ion recombination between $Naph^+$ and the negative ion of the competing scavenger. The secondary process occurring in the sulphur hexafluoride and chloracetic systems are more complex and an empirical fit of the data was not possible. (auth)

45331 RADIATION-INDUCED FORMATION OF EXCITED STATES OF AROMATIC HYDROCARBONS IN BENZENE AND CYCLOHEXANE. I. RADIATION INDUCED FLUORESCENCE FROM SOLUTIONS OF AROMATIC HYDROCARBONS IN CYCLOHEXANE. Frankevich, E. L.; Morrow, T.; Salmon, G. A. (Univ. of Leeds, Eng. Cookridge Hospital, Leeds, Eng.). Proc. Roy. Soc. (London), Ser. A; 328: No. 1575, 445-56(27 Jun 1972).

The nature of radiation-induced fluorescence from solutions of anthracene, naphthalene, and pyrene in cyclohexane was investigated. Evidence is presented for the formation of excited singlet solute molecules via charge recombination processes. Rate constants, measured by the pulse radiolysis technique, are reported for the quenching of excited singlet state molecules of naphthalene and pyrene by oxygen, xenon, iodine, 1,3-cyclohexadiene, nitrous oxide, sulphur hexafluoride and nitromethane. (auth)

45332 RADIOLYSES OF MIXTURES OF AMMONIA AND HYDROCARBONS. II. FORMATION OF HYDROGEN FROM MIXTURES OF AMMONIA AND OLEFINS (ETHYLENE, PROPYLENE, AND BUTADIENE). Hamanoue, Kumao; Okamoto, Jiro; Tokunaga, Okihiro; Danno, Akibumi (Japan Atomic Energy Research Inst., Tokai). Bull. Chem. Soc. Jap.; 45: No. 5, 1306-10(May 1971).

Gamma radiolyses of gaseous mixtures of ammonia and olefins (ethylene, propylene, and butadiene) were investigated over the whole composition range of mixtures, and consideration was given on the primary processes of hydrogen formation. From the extrapolated values of $G(H_2)$ obtained in the γ-radiolyses of the mixture of ammonia and olefins, it was found that the non-scavengeable $G(H_2)$ of ammonia, ethylene, propylene and butadiene was 0.68–0.72, 1.26, 1.06, and 0.33, respectively. Gas-phase radiolyses of ammonia–perdeuterated olefin mixtures were also investigated. From kinetic calculation on the data of isotopic mixtures of hydrogen, the following results were obtained; (1) both thermal and non-scavengeable hydrogen molecules are produced by the γ-radiolysis of ammonia, and the non-scavengeable hydrogen molecules are produced for the most part by a unimolecular process, (2) almost all the hydrogen molecules produced by the γ-radiolyses of olefins (ethylene, propylene, and butadiene) are non-scavengeable; a unimolecular process plays an important role in the case of ethylene, and in other cases a bimolecular process. $G(H_2)$ of the butadiene radiolysis is very small compared with that of other olefins and with the calculated value of butadiene, i.e., $G(H_2) < 1$. The discrepancies can be interpreted in terms of the addition reaction of the "hot" hydrogen radicals to butadiene to form t-2-butene. (auth)

45333 THEORETICAL CONSIDERATION OF THE ELECTRON-SCAVENGING PROCESS IN LIQUID HYDROCARBONS. III. INTEGRAL TRANSFORMS OF THE DISTRIBUTION FUNCTIONS. Yamazaki, Hideo; Shinsaka, Kyoji (Tokyo Inst. of Tech.). Bull. Chem. Soc. Jap.; 45: No. 5, 1335-8(May 1972).

The relations of integral transforms between various distribution functions are discussed using the potential control approximation ignoring the diffusion term in the Smoluchowski equation; the initial spatial distribution of the electron-ion pair or the initial distribution of electrons from the central ion core in a spur, $\chi(r,0)$; the relative G-value of electron recombination, $G(k_sC_s)$, as a function of the concentration of the scavenger and the rate constant; the time dependence of the electron concentration, N(t), after pulse irradiation; and the relaxation time spectrum, K(n), of the decay of the electron concentration after pulse irradiation or of the weight function, K(n), in the initial exponential distribution of thermalized electrons in a spur are shown to be connected by the square diagram of Laplace transforms:

$$\begin{array}{ccc} K(n) & \xrightarrow{\text{Laplace Transform}} & \chi(r,0) \\ \text{Laplace Transform} \downarrow & & \downarrow \text{Laplace Transform} \\ N(t) & \xrightarrow{\text{Laplace Transform}} & G(k_sC_s) \end{array}$$

By the use of this relation, the various distribution functions are evaluated from the empirical formulas of $G(k_sC_s)$ proposed by Schuler et al. and by Hummel. (auth)

45334 ACTIVE SPECIES OF γ-IRRADIATED VINYL ACETATE AND THEIR CHANGES ON IRRADIATION OF VISIBLE LIGHT. Hirai, Hidefumi; Fujiwara, Masato (Tokyo Univ.). Nippon Kagaku Kaishi; No. 5, 968-74(May 1972). (In Japanese).

Free radicals produced by the γ-irradiation of vinyl acetate in the solid state were studied with electron spin resonance (ESR) and the changes of these radicals on the visible light irradiation were also examined. An oriented solid of vinyl acetate was prepared for ESR measurement by the solidification of vinyl acetate around an aluminum rod at −196°C or −117°C and with subsequent γ-irradiation (dose; 8×10^6 rad) at −196°C. The oriented crystalline solid prepared at −117°C gives an ESR spectrum consisting of a singlet and additional adsorptions in the dark at −196°C. After irradiation by visible light for 10 minutes, ESR spectra of the oriented crystalline solid exhibit a distinct hyperfine structure and a definite anisotropy on the rotation of the solid in the dc magnetic field. These spectra consist of a quartet (A_1 = 12.5 G), an anisotropic triplet and an equivalent four lines (A_1 = 103 G, A_2 = 16 G), corresponding to the radicals, $CH_3COO\cdot$, $\cdot CH_2COOCH = CH_2$, and $CH_2 = CH$, respectively. Prolonged irradiation with visible light for 300 minutes yields the apparent five lines, consisting of a pair of triplet (A_1 = 10G, A_2 = 20G) and the above-mentioned triplet corresponding to the radicals $\cdot CH_2CHO$ and $\cdot CH_2COOCH = CH_2$, respectively. The spectrum of the γ-irradiated glassy solid prepared at −196°C consists of strong four lines, which is confirmed to be isotropy, and of a weak doublet split by 120 G, corresponding to the vinyl radical. Irradiation of the glassy solid with visible light for 30 minutes gives a sharp quartet (A_1 = 23 G) assigned to $CH_3\cdot$ produced by the photolysis of $CH_3COO\cdot$. A broad triplet (A_1 = 22 G) becomes observable on elevation of the temperature to −160°C and remains up to −100°C. This triplet is assigned to $\cdot CH_2COOCH = CH_2$. In conclusion, both the crystalline and the glassy solids produce the same radicals on γ-irradiation. (auth)

45335 SYNTHESIS OF OXYGEN-CONTAINING HALOGENATED COMPOUNDS. II. γ-RAY INDUCED REACTION OF CYCLOHEXANONE IN THE PRESENCE OF CHLORINATED HYDROCARBONS. Yumoto, Takaari (Government Industrial Research Inst., Nagoya, Japan); Matsuda, Tatsuo. Nippon Kagaku Kaishi; No. 5, 940-4(May 1972). (In Japanese).

Cyclohexanone was irradiated with γ rays in the presence of some chlorinated hydrocarbons. The main products were confirmed to be 2-(1-cyclohexenyl)cyclohexanone [1] and 2,6-di(1-cyclohexenyl)cyclohexanone [2]. Any expected condensation product between cyclohexanone and chlorinated hydrocarbons was not detected. The rates of formation of [1] and [2] were found to be nearly proportional to the dose rate. A maximum yield of 47.5% of

[1] was obtained in the presence of 20% moles of tetrachloroethylene. The effect of the coexistence of chlorinated hydrocarbons on the yields of [1] and [2] decreased in the order: tetrachloroethylene > trichloroethylene > cis-1,2-dichloroethylene, carbon tetrachloride > chloroform > methylene chloride > 1,1-dichloroethane. The reaction mechanism for the formation of [1] and [2] was discussed. (auth)

45336 INDUCING DYEABILITY IN POLYPROPYLENE BY RADIATION INDUCED GRAFTING. DasGupta, S. (to Atomic Energy of Canada Ltd.). Canadian Patent 892,730. 8 Feb 1972.

A process for improving the dyeability of polypropylene, particularly polypropylene fibers and fabrics, is described. The polypropylene is impregnated with polymerizable unsaturated organic monomer containing hydrophilic groups, either individually or in admixture, or as mixtures with styrene. The monomer(s) are in solution in a substantially anhydrous primary alcohol, preferably methanol or ethanol. The monomer-impregnated polypropylene is subjected to high energy ionizing radiation, such as ^{60}Co gamma radiation, and the monomers are thereby graft colpolymerized with the polypropylene. Such grafted polypropylene products can be dyed very easily. The dyed fabrics are soft to handle, have dye stability, light- and washfastness, moisture retention, resistance to static charge, and retain all of the desirable properties of ungrafted polypropylene. (Canada)

45337 1,6-GLUCODIALDOSE AS ONE OF THE RADIOLYSIS PRODUCTS OF D-GLUCOSE-6-PHOSPHATE. Kochetkov, N. K.; Kudryashov, L. I.; Chlenov, M. A.; Grineva, L. P. (Inst. of Organic Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 202: No. 4, 847-9(1 Feb 1972). (In Russian).

The radiolysis of D-glucose-6-phosphate was studied by subjecting a 10^{-2} M aqueous solution to ^{60}Co gamma radiation at a rate of 6.5×10^{16} eV/ml · sec. It was postulated that the radiation caused a rupture of the phosphate bond, and to a significant degree carbon-6 is oxidized. The radiolysis was conducted under different gaseous atmospheres (N_2, N_2O, and O_2). In all cases one of the chief radiolysis products was 1,6-glucodialdose. (K.S.W.)

45338 RADIATION DAMAGE TO POLYMER FIBER STRUCTURE AS INVESTIGATED BY THE METHOD OF SMALL-ANGLE X-RAY SCATTERING. Plavnik, G. M.; Goryaev, V. M.; Spitsyn, Vikt. I.; Ryabchikova, G. G.; Berestnev, V. A. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 202: No. 4, 878-81(1 Feb 1972). (In Russian).

Experiments were conducted on fibers of Kapron cord in air and in vacuum by subjecting them to various forms of ionizing radiation: accelerated electrons at energies of 1 to 5 MeV or gamma radiation from a ^{60}Co source, varying the dose from 0.5 to 3,000 MR. X-ray diffraction patterns were taken with a four-slit small-angle camera, using CuK_α radiation. Significant differences were apparent at large radiation doses: for irradiation in air the intensity of reflection dropped by a factor of 4 for a 500 MR dose relative to the original sample; irradiation in a vacuum yielded an analogous decrease in the intensity only at a dose of 1,500 MR. It was concluded that the method of small-angle scattering of x rays is extremely sensitive to processes evolving in polymeric fibers subjected to radiation, and allows quantitative evaluation of the extent of these processes. (K.S.W.)

45339 METHOD FOR THE POLYMERIZATION AND/OR THE CROSS-LINKING OF ACRYLIC POLYMERS OR COPOLYMERS. Blin, Marie-Francoise; Gaussens, Gilbert (to Commissariat a l'Energie Atomique). French Patent 2,076,863. 20 Sep 1971. Filed 30 Jan 1970. (In French).

A method for obtaining radiation-induced polymerization and/or cross-linking of acrylic polymers in the presence of air was developed, for all thicknesses of material. The process consists of preparing an acrylic satured resin dissolved in vinyl monomers, and the subsequent radiation-induced shaping and cross-linking of the resin in the presence of air. (France)

45340 ABSORPTION SPECTROSCOPY OF TRANSIENT SPECIES. Herkstroeter, William G. (Eastman Kodak Co., Rochester, N. Y.). pp 521-76 of Physical Methods of Chemistry. Pt. IIIB. /Weissberger, Arnold (ed.). New York; John Wiley and Sons, Inc. (1972).

Absorption spectroscopy of transient species is reviewed including absorption of stabilized transients utilizing conventional spectroscopic techniques, flash photolysis, pulse radiolysis, optimum solute concentrations with lateral excitation, determination of transient extinction coefficients, and transient kinetics. (D.H.M.)

45341 ELECTRON SPIN RESONANCE STUDY OF RADICALS FORMED BY HIGH-ENERGY IRRADIATION OF K_2PdCl_4 AND K_2PtCl_4. Krigas, Thomas Michael. East Lansing, Mich.; Michigan State Univ. (1971). 138p. University Microfilms Order No. 72-16,460.

Thesis.

All known square-planar complexes of Pt(II) and Pd(II) are diamagnetic with d^8 electron configurations and therefore cannot be studied by electron spin resonance spectroscopy. Several new paramagnetic species were produced by high-energy irradiation of solid diamagnetic compounds to give Pt and Pd containing radicals in which one-electron oxidation or reduction has occurred. The structures of these species were obtained from electron spin resonance studies. The X-band electron spin resonance spectra of single crystals of K_2PdCl_4 and K_2PtCl_4 that were irradiated by γ rays from a ^{60}Co source or by 1-MeV electrons were studied at temperatures between 77 and 296°K with the primary purpose of elucidating the structure and bonding in species showing unusual oxidation states of palladium and platinum. Irradiation of $K_2Pd(II)Cl_4$ produced two identifiable paramagnetic radicals: one is shown to be $(Pd(I)Cl_4)^{3-}$ with a $4d^9$ electron configuration and the unpaired electron in a $d_{x^2-y^2}$ orbital; the second radical is believed to be $(Pd(III)Cl_5)^{2-}$ with the unpaired electron in a $4d_{z^2}$ platinum atomic orbital. Crystals of $K_2Pt(II)Cl_4$ irradiated at 77°K show two groups of electron spin resonance lines: one belongs to a radical that shows hyperfine interaction with two equivalent platinum nuclei; the second arises from a radical showing hyperfine interaction with one platinum and three chlorine nuclei. It is suggested that these species are $\{(Pt(II)Cl_4)^-(Pt(III)Cl_4)\}^{3-}$ and $(Pt(I)Cl_3)^{2-}$, respectively, where the metal electron configurations are $5d^{15}$ and $5d^9$. On warming to 125°K some of the dimeric radical is converted to a new species whose spectra are consistent with those predicted for $(Pt(III)Cl_5)^{2-}$. Thus, each identifiable radical contains platinum or palladium in which the original diamagnetic, low spin, d^8 configuration of the metal ion M(II) (M = Pt or Pd) was oxidized or reduced to form paramagnetic species with the metal in the unusual oxidation states M(III) or M(I). Energy level schemes for each radical are proposed based upon the electron spin resonance spectra. The nature of the metal-chlorine bonds in the new species is discussed and the extent of covalency is estimated by using a simplified molecular orbital picture. (Diss. Abstr. Int., B)

45342 KINETIC ISOTOPE EFFECTS IN FREE RADICAL CHEMISTRY. Kneipp, Kenneth George. Baton Rouge, La.; Louisiana State Univ. (1971). 226p. University Microfilms Order No. 72-17,778.

Thesis.

Kinetic isotope effects for hydrogen atom abstraction from mercaptans by free radical species were investigated. A variety of structurally different radicals were generated by thermolytic, photochemical, and radiolytic techniques and allowed to abstract hydrogen, deuterium, or tritium atoms from the S-H position of a mercaptan molecule. The rate ratio, or isotope effect, k_H/k_D or k_H/k_T, was measured in all cases as a function of temperature. A useful relationship was developed whereby the magnitude of the observed isotope effect, or isotopic selectivity, for a given radical may be correlated to its stability or reactivity. Such a pattern of isotope effects for abstraction should prove useful as a diagnostic test for radical species whose reactivity may otherwise be difficult to assess. Secondary deuterium isotope effects on thermolysis of perester initiators were measured in order to elucidate the mechanism of decomposition of these free radical precursors. The results are shown to be in good agreement with similar secondary isotope effect measurements reported in the literature and the mechanistic implications are consistent with results obtained using a variety of investigation techniques. (Diss. Abstr. Int., B)

45343 I. RADIATION DAMAGE IN MALONIC ACID: AN ACYL RADICAL. II. DEUTERON DISTANT ENDOR STUDIES. McCalley, Roderick Canfield. Cambridge, Mass.; Harvard Univ. (1971). 250p. University Microfilms Order No. 72-18,635.

Thesis.

The radical $RCH_2\dot{C}{=}O$ (where R- is HOOC-) was unexpectedly discovered in x-irradiated malonic acid single crystals. Its most obvious ESR parameters, g tensor (1.9964, 2.0018, 2.0039) and "outer" ^{13}C hyperfine tensor (498½, 383, 372½ MHz), indicate a $-\dot{C}{=}O$ type "σ" radical, but are not sufficient to unambiguously distinguish the proposed species from ·COOH. An "inner" ^{13}C hyperfine splitting (172, 133, 132 MHz) and the two proton hyperfine tensors (+6, −13, −16 MHz), as well as the geometry of all the tensors, do confirm the $RCH_2\dot{C}{=}O$ assignment. An analogous species, located at the opposite end of the malonic acid molecule, exhibits a hindered rotation of its $-\dot{C}{=}O$ group at room temperature, averaging out 75% of the magnetic anisotropy in the plane $\perp$ to its C−C axis. For these substituted acetyl radicals, the spin distribution and properties (especially the large second ^{13}C interaction and the anomalously low and negative β-proton splittings) are discussed and explained in terms of general "rules" for

spin-delocalization and dipolar coupling. In deuterated malonic acid (d-Mal) about 45 to 50% of the radicals created by a short X-irradiation at 300°K are $RCH_2\dot{C}=O$, compared to only 25 to 30% in h-Mal. For the aging of $RCH_2\dot{C}=O$ at room temperature, the halftime is less than 2 hr in h-Mal and about 1 day in d-Mal. The ENDOR spectra of d-Mal at 4°K include very strong and narrow signals from the "distant" deuterons and naturally abundant ^{13}C (up to 80% and 25%, respectively, of the ESR baseline). Enough geometrical information is available from the splitting tensors to draw a fairly comprehensive picture of the 4°K crystal structure, particularly with respect to the manner in which the room temperature center of symmetry (between the two molecules in the unit cell) seems to be lost in cooling to 4°K. (Diss. Abstr. Int., B)

45344 STUDIES OF CONTINUOUS DIELECTRIC MODELS FOR SOLVATED ELECTRONS. Meglen, Robert Rudolf. Boulder, Colo.; Univ. of Colorado (1971). 200p. University Microfilms Order No. 72-17,286.

Thesis.

The evolution of dielectric models for the solvated electron is described. Early models greatly influenced the basic assumptions of the more recent models. The early particle-in-a-spherical box model was modified by J. Jortner. The Jortner cavity model is discussed. The basic assumptions made in the Jortner model were evaluated. A Self Consistent Field–Continuous Dielectric (SCF-CD) model for the solvated electron is presented. This model does not require the assumption of a cavity. The wave functions and energies are determined self-consistently by a numerical integration of the Schrödinger Equation. This model gives results that are comparable to the cavity model. Three modifications of the SCF-CD model are given. The effect of introducing a cavity into the model was evaluated by performing a set of SCF calculations with a variety of assumed cavity radii. The results of these calculations are compared to the results of the Jortner cavity calculations. A second modification of the SCF-CD model allows a continuously variable solvent density in the neighborhood of the additive electron. The reduction in solvent density is assumed to be proportional to the additive electron density, and it is treated self-consistently. The third modification makes use of the pseudopotential method. A repulsive term is added to the potential energy function to account for the additive solvated electron. The transition energy of the solvated electron in various solvents, the width of the absorption band, the temperature, and pressure dependence of the absorption maximum are discussed. None of the SCF-CD modifications provides a satisfactory explanation of the observed properties of the solvated electron. The variation in transition energy with solvent is difficult to interpret with present models. The width of the absorption band can not be explained by a Rydberg type series of electronic transitions. The most serious shortcoming of these modifications is that they predict the wrong sign for the temperature and pressure dependence of the absorption maximum. It was concluded that these difficulties are not caused by the assumption of a continuous dielectric medium. The difficulty is believed to be due to an incorrect form of the polarization potential. A brief description of some calculations of the onset of metallic conductivity is included in an appendix. This calculation treats the onset of metallic conductivity as a case of the Mott transition. (Diss. Abstr. Int., B)

45345 ROLE OF FLUORIDE ION IN IRRADIATED AQUEOUS SYSTEMS. Bales, Barney L. (California State Univ., Northridge); Kevan, Larry. J. Chem. Phys.; 57: No. 4, 1813-14(15 Aug 1972).

A mechanism for explaining the role of fluoride ions in irradiated aqueous systems is proposed that led to the conclusion that more e_t^- is produced in F^--doped ice because of chemical means rather than physical means: the same number and type of traps are available in ice and F^--doped ice and are unrelated to the presence of that ion. (D.H.M.)

45346 γ RADIOLYSIS OF GASEOUS CARBON DIOXIDE AT HIGH DENSITIES. Yoshimura, M.; Chosa, M.; Soma, Y.; Nishikawa, M. (Tokyo Univ.). J. Chem. Phys.; 57: No. 4, 1626-31 (15 Aug 1972).

The γ radiolysis of gaseous carbon dioxide was investigated at 50 ± 1°C over the density range of 0.2 to 0.6 g/ml. At density of around 0.5 g/ml, G(CO) from pure carbon dioxide showed a very marked increase. Addition of SF_6 at these densities efficiently reduced G(CO). From this it appears that formation of carbon monoxide results mostly from charge neutralization. Examination of the mechanisms in the radiolysis of carbon dioxide in gas and liquid phase, and a calculation on a simple model indicate that this neutralization is of geminate character. Upon addition of hydrocarbons which react with oxygen atoms as well as the addition of both hydrocarbons and SF_6, G(CO) passed through a maximum and reached the value of 2.2 at higher concentrations of hydrocarbons, independent of density. It was interpreted that (1) the positive ions involved in neutralization are probably clustered CO_2^+ in agreement with the above inference, and that (2) there are at least two species responsible for the rapid re-oxidation of CO. (auth)

45347 ESR STUDY OF THE VINYL-TYPE RADICAL TRAPPED IN A SINGLE CRYSTAL OF MALEIC ACID IRRADIATED AT 77°K. Eda, Bunzo; Iwasaki, Machio (Government Industrial Research Inst., Nagoya, Japan). J. Chem. Phys.; 57: No. 4, 1653-60(15 Aug 1972).

The substituted vinyl radical, $DOOC-CH=\dot{C}H$, trapped in an irradiated single crystal of maleic acid-d_2 was studied by ESR to elucidate the geometrical and electronic structure of the vinyl-type radical. The hyperfine tensors for the ^{13}C and β proton couplings were determined to be (+133.8, +75.3, +62.2)G and (+59.5, +57.5, +56.8)G, respectively, in addition to the α proton coupling and g tensors preliminarily reported. All the magnetic tensors determined are consistent with the planar structure of the vinyl-type radical in which the unpaired electron occupies the in-plane sp hybrid orbital. The ^{13}C hyperfine tensor indicates the relatively large spin density in the $C_{2p\sigma}$ orbital which is consistent with the small s character of the vinyl-type radical. The relative orientation of the hyperfine tensor of the α proton to that of ^{13}C gives the clear evidence for the bent structure of the radical carbon atom. The dipolar tensor of the α proton coupling has been calculated using the spin distribution and the geometry obtained in our experiments, and the results are in good agreement with the observation in its magnitude as well as its directions. The apparent difference in the α proton coupling between C–H π and σ radicals has been discussed in relation to the sign of the isotropic coupling. (auth)

45348 RADICAL ION SATURATION IN SOME SULFUR COMPOUNDS X-IRRADIATED AT 4.2°K. Box, Harold C.; Potter, William R.; Budzinski, Edwin E. (Roswell Park Memorial Inst., Buffalo). Contract AT(30-1)-3558. Radiat. Res.; 51: No. 1, 10-14(Jul 1972).

Single crystals of dimethylthiourea and dibenzoyl disulfide were exposed to ionizing radiation at 4.2°K. At this temperature positive and negative free radical ions are stable and can be identified from their electron spin resonance (ESR) absorption spectra. The concentration of radical ions was measured as a function of dose and it was found that the concentrations approach limiting values of the order of 10^{18} radicals per gram. This "saturation" effect is attributed to nongeminate recombination of electrons with cations. (auth)

45349 ELECTRON SPIN RESONANCE STUDIES AND INDO MO-CALCULATIONS OF ELECTRON IRRADIATED PEPTIDES. A SINGLE CRYSTAL OF N-ACETYLGLYCINE. Saxeboel, Gunnar; Meloe, Thor B.; Henriksen, Thormod (Univ. of Oslo). Radiat. Res.; 51: No. 1, 31-44(Jul 1972).

The radicals induced by radiation in single crystals of N-acetylglycine, grown from both H_2O and D_2O solutions, were studied using both ESR spectroscopy and INDO MO-calculations. At room temperature the radical $H_3C \cdot CO \cdot NH \cdot \dot{C}H \cdot COOH$ was formed as previously demonstrated. In these experiments the detailed distribution of the unpaired spin density was studied both through the ESR observations and by MO-calculations. The two methods were in satisfactory agreement. It was found that the unpaired electron was largely delocalized and even δ-proton interaction was found. Furthermore, the observation that unpaired spin density can migrate through the peptide group may have some bearing with regard to the processes taking place in irradiated proteins. (auth)

45350 RADIOLYSIS OF AQUEOUS SOLUTIONS OF NICKEL(II) ETHYLENEDIAMINE TETRAACETATE. Bhattacharyya, S. N.; Kundu, K. P. (Saha Inst. of Nuclear Physics, Calcutta). Radiat. Res.; 51: No. 1, 45-55(Jul 1972).

Neutral aqueous solutions of nickel(II) ethylenediaminetetraacetate (N) were irradiated with x rays both in the presence and in the absence of dissolved oxygen, and the radiolytic degradation of the metal chelate was determined. Hydrogen peroxide and formaldehyde that were produced in the system were also determined. A radiolytic mechanism was proposed and discussed where it was argued that the radiolytic degradation at the ligand is due to OH only. Effect of methanol and formate was also studied and the ratios of the rate constants, $K(OH + CH_3OH)/K(OH + N)$ and $K(OH + HCOO^-)/K(OH + N)$ were found to be 0.32 and 1.64, respectively. (auth)

45351 EFFECT OF PRESSURE ON THE RATES OF REACTION OF SOLVATED ELECTRONS IN LIQUID ETHANOL. Jha, Kamal N.; Freeman, Gordon R. (Univ. of Alberta, Edmonton). J. Chem. Phys.; 57: No. 4, 1408-14(15 Aug 1972).

At a γ radiolysis dose of 1×10^{18} eV/g in ethanol at 296°K the hydrogen yields in neutral ethanol were $G(H_2) = 5.0$ at 1 bar and 5.5 at 5.3 kbar; in 1 mM and 1 M sulfuric acid $G(H_2) = 5.7$, independent of pressure. The electron scavengers nitrobenzene, acetone, and naphthalene reduce the hydrogen yields in neutral and acidic ethanol at 1 bar and 5.3 kbar; increasing the pressure greatly reduces the ease of scavenging the free ions but has only a small effect on scavenging efficiency in the spurs. Using as a standard the reaction $e^-_{solv} \rightarrow C_2H_5O^-_{solv} + H$ with $k = 1.2 \times 10^5$ sec^{-1} at 1 bar and $\Delta V^{\ddagger} = -14.4$ cm^3/mole averaged between 0 and 5.3 kbar, one obtains the following values for $k(M^{-1}\ sec^{-1})$ and $\Delta V^{\ddagger}$ (cm^3/mole) : $e^-_{solv} + H^+_{solv}$, 2.8×10^{10} at zero ionic strength, +4.5; $e^-_{solv} + C_6H_5NO_2$, 1.5×10^{10}, +7.5; e^-_{solv} + naphthalene, 5.0×10^9, +5.6; $e^-_{solv} + CH_3COCH_3$, 4.2×10^9, +5.1. The diffusion coefficient of solvated electrons in ethanol appears to correlate with the liquid viscosity; this is different from the behavior of electrons in alkanes. In ethanol $\Delta V^{\ddagger}_{diffusion} \approx +7$ cm^3/mole for e^-_{solv} and +4 cm^3/mole for H^+_{solv}. The free ion yield in ethanol is $G(e^-_{solv})_{fi} = 1.7$, independent of pressure from 1 bar to 5.3 kbar; the model of Freeman and Fayadh [J. Chem. Phys. 43: 86 (1965)] is consistent with this behavior and it predicts that G_{fi} in methanol and water is also independent of pressure. (auth)

45352 CROSSLINKED POLYVINYL CHLORIDE OR POLYVINYLIDENE FLUORIDE FILM. Hahn, Ernest A. (to PPG Industries, Inc.). U. S. Patent 3,676,192. 11 Jul 1972. Filed 6 Apr 1970.

Coating compositions comprising poly(vinyl chloride) or poly (vinylidene fluoride) are prepared by mixing a solution of the poly(vinyl chloride) or poly(vinylidene fluoride) in an active solvent with an acrylic monomer and subjecting the mixture to ionizing irradiation. The cured films are hard, stain-resistant, heat-resistant, and mar-resistant. (Official Gazette)

45353 ION-MOLECULE REACTIONS IN AMMONIA AT HIGH PRESSURES. Wincel, Henryk (Inst. of Nuclear Research, Warsaw). J. Mass Spectrom. Ion Phys.; 9: No. 3, 267-85(Aug 1972).

Ion–molecule reactions in gaseous ammonia were examined at pressures up to 2 torr in a high-pressure mass spectrometer. Solvation of ammonium ions as well as other ions in both NH_3 and ND_3 studies was observed. The stability of the solvates $NH_4^+(NH_3)_n$ diminishes with increasing degree of solvation. The effect of the energy of the ionizing electrons on the yields of solvated and other ions was studied. Evidence for the formation of excited states of NH_4^+, $NH_4^+NH_3$, $NH_4^+(NH_3)_2$, etc., and collisional de-excitation processes was obtained. Only NH_4^+ ions reach thermodynamic equilibrium at the ion-source pressures used in these experiments. (auth)

45354 ELECTRON AND HYDROGEN ATOM ATTACHMENT TO AROMATIC CARBONYL COMPOUNDS IN AQUEOUS SOLUTION. ABSORPTION SPECTRA AND DISSOCIATION CONSTANTS OF KETYL RADICALS. Hayon, E.; Ibata, T.; Lichtin, N. N.; Simic, M. (Army Natick Labs., Mass. Boston Univ.). J. Phys. Chem.; 76: No 15, 2072-8(20 Jul 1972).

The technique of pulse radiolysis-absorption spectroscopy was used to study the addition of hydrated electrons and H atoms to a number of compounds incorporating both carbonyl and aromatic groups. The absorption spectra of the electron adducts and their oxygen-protonated conjugate acids were determined for acetophenone, 9,10-anthraquinone-2-sulfonate, benzamide, benzil, benzoin, benzophenone, and fluorenone. The pK_a values for all of these radicals except those derived from benzoin were evaluated as were the bimolecular decay rates of the anion radicals. Bimolecular decay rates of the protonated electron adducts of acetophenone, 9,10-anthraquinone-2-sulfonate, and benzamide were also measured. Specific rates of addition of the hydrated electron to all the substrates for which resultant spectra were determined as well as anthrone, dibenzylketone, 1,4-naphthoquinone-2-sulfonate, 1,2-naphthoquinone-4-sulfonate, and phenylacetone have been found to fall in the range $(1.1-3.6) \times 10^{10}$ M^{-1} sec^{-1}. Spectra of the H-atom adducts and bimolecular specific rates of decay of these adducts have been determined for acetophenone, 9,10-anthraquinone-2-sulfonate, benzamide, benzil, benzophenone, fluorenone, and 1,4-naphthoquinone-2-sulfonate. Systematic aspects of the dependence on structure of the reactivity toward addition of e^-_{aq} and H atoms, of the pK_a's of protonated electron adducts, and of the various spectra are discussed. (auth)

45355 METHOD OF MODIFYING POLYMERIC MATERIALS, WOOD, AND ARTICLES MADE THEREFROM BY RADIATION-INITIATED GRAFT COPOLYMERIZATION THEREOF. Kabanov, Vitaly Yakovlevich; Voronkov, Nikolai Andreevich; Kochkin, Dmitry Alexandrovich; Spitsyn, Viktor Ivanovich; Kazamanova, Iraida Vasilievna (to Institut Fizicheskoi Khimii Akademii Nauk SSSR). British Patent 1,269,297. 6 Apr 1972. Filed 17 Jul 1970.

A method is presented for the modification of synthetic polymers and wood in order to render them fungus resistant. The method described comprises contacting the material with a trialkylacryloxystannane, and in particular triethylmethacryloxystannane, and solution graft polymerising this onto the material under the action of γ-radiation. Irradiation is carried out until not less than 0.5% by weight of the oxystannane, based on the weight of polymer or wood, has been grafted. The materials so produced are fungus resistant and have long service life, since the grafted material cannot be removed under practically all service conditions. The preferred modes of conducting the process are described. The dosage of γ radiation for polymers is suitably 0.1 to 0.5 MR and the absorbed dose rate 0.3 to 5 R/sec, and for wood 80 to 100 R/sec with an exposure time of 30 to 50 hr. Irradiation may be before or after contact with the oxystannane. A number of examples are given. (UK)

Radiochemistry and Nuclear Chemistry

Refer also to abstracts: 45288, 45311, and 45927.

Hot-Atom Chemistry

45356 EFFECTS OF PRE-IRRADIATION TREATMENTS ON THE CHEMICAL BEHAVIOR OF ^{64}Cu RECOIL ATOMS IN NEUTRON-IRRADIATED COPPER PHTHALOCYANINE. Kudo, Hiroshi (Japan Atomic Energy Research Inst., Tokai). Bull. Chem. Soc. Jap.; 45: No. 5, 1311-13(May 1972).

The chemical behavior of ^{64}Cu recoil atoms was studied in copper phthalocyanine that had been quenched from an elevated temperature or exposed to ^{60}Co γ-rays before the neutron irradiation. In the quenched β-crystal, the initial retention was found to increase with an increase in the temperature or pre-irradiation heating, while the plateau retention of the post-neutron annealing reaction decreased. These results were compared with those for cadmium phthalocyanine and were understood in terms of "dislocation" in the crystal, the recoil atoms being assumed to be trapped and stabilized in the "dislocation." Although the variations were small, the irradiation with ^{60}Co γ-rays caused a change in the chemical behavior of the recoil atom. The role of some radiation-induced species was discussed. (auth)

45357 NUCLEAR RECOIL REACTIONS IN ORGANOMANGANESE COMPOUNDS. VI. $IMn(CO)_5$ AND $BrMn(CO)_5$. De Jong, I. G.; Wiles, D. R. (Carleton Univ., Ottawa). Can. J. Chem.; 50: No. 7, 961-5(1 Apr 1972).

Radiochemical reactions of ^{82}Br, ^{128}I, and ^{56}Mn were studied in neutron-irradiated $BrMn(CO)_5$ and $IMn(CO)_5$. The parent compounds were found to contain 49 and 28% of the ^{82}Br and ^{128}I, but only 6 and 10% of the ^{56}Mn, respectively. The dimeric $[XMn(CO)_4]_2$ accounted for 28% of the ^{82}Br, but only about 2% of the ^{56}Mn. Some $^{56}Mn_2(CO)_{10}$ was also found. The radiochemical yields of several products were found to increase substantially on thermal treatment of the target material. Reaction pathways are suggested which can account for the thermal effects, which involve halogen atom transfer and carbonyl transfer in the solid. (auth)

45358 CHEMICAL EFFECTS ASSOCIATED WITH THE THERMAL NEUTRON IRRADIATION OF SOLID ACETANILIDE (ANTIFIBRIN). Barakat, M. F.; Zahran, A. H. (Atomic Energy Authority, Cairo). Radiochim. Acta; 17: No. 2, 65-8(Jul 1972).

Reactions of recoil ^{14}C atoms were studied in a neutron-irradiated acetanilide system. The reaction mechanisms in solid systems are discussed with reference to those occurring in simple gaseous and liquid systems. The "random fragmentation" hypothesis seems to offer an adequate explanation. Most of the products identified were the result of different recombination processes between fragments formed by the severe fragmentation of the irradiated material. ^{14}C-labeled acetanilide was obtained with the highest radiochemical yield. The radiochemical yields of the simple synthetic products were higher than those of more complicated products. Labeled methyl derivatives were not detected. The infrared spectrum of the polymer separated showed a marked similarity, in absorption bands, to the spectrum of pure acetanilide except for the possible appearance of $-CH_2-$ groups in the polymer spectrum. (auth)

45359 CHARGE STATES OF ^{208}Pb AND ^{208}Tl FORMED BY α DECAY OF ^{212}Po AND ^{212}Bi. Meyer, J.; Paulus, J. M.; Abbe, J. Ch. (Centre de Recherches Nucleaires, Strasbourg). Radiochim. Acta; 17: No. 2, 76-81(Jul 1972). (In French).

Charge states of ^{208}Pb and ^{208}Tl formed from the α decay of a

solid deposit of ^{212}Po and ^{212}Bi were analyzed by electrostatic deflection. In the absence of an internal conversion, the charge of recoils varies from −1 to +6. The yields of $^{208}Pb^{+}$ and $^{208}Pb^{0}$, $^{208}Tl^{+}$ and $^{208}Tl^{0}$ are of the same order of magnitude, but the intensities of $^{208}Pb^{n+}$ and $^{208}Tl^{n+}$ decrease strongly when the charge increases. The mean charge is less than one. The backing influences the charge carried by the recoil as it leaves the surface. The diffusion of the parent into the backing diminishes the yields of the multicharged daughters. When α decay is followed by internal conversion, the charge spectrum of $^{208}Tl^{n+}$ lies between +5 and +20 with a mean charge of +12. This charge distribution is the result of vacancy cascades initiated by internal conversion in the L or M shell. In this case, no effect of the backing has been observed. (auth)

45360 CHEMICAL EFFECTS OF ISOMERIC TRANSITION IN BROMOETHANE MIXTURES. da Fonseca, A. J. R.; Shaw, D.; Shaw, P. F. D. (Oxford Univ.). Radiochim. Acta; 17: No. 2, 81-95(Jul 1972).

The distribution of products from the decay of ^{80m}Br, combined initially as bromine or bromoethane, was determined in bromoethane–bromine mixtures at room temperature. Comparative results at −80°C were also obtained with ^{80m}Br present initially as hydrogen bromide. Analysis was made using novel G.L.C. separation involving two columns in series. While the overall magnitude of the yields of ^{80}Br labeled products is roughly independent of the initial form of ^{80m}Br, the intensity of the chemical damage, judged by the degree of bromination or the extent of C–C bond schism, appears to be correlated with the magnitude of the charge transferred from the freshly formed ^{80}Br atoms to bromoethane molecules. While radiolysis by Auger electrons may be partly responsible for part of the diffusive yields, it cannot account for the overall distribution of atoms which have undergone internal conversion, or, indeed, any other form of nuclear activation studied in the bromoethane–bromine system. It was also possible to show that the kinetic energy gained by mutual repulsion of charged atoms is insufficient to account for the observed product distribution. Several of the most important features of the distribution are satisfied by a model which assumes that dissociation (by mutual electrostatic repulsion) and neutralization occur at similar rates so that the faster dissociative processes, and the free radicals produced by them, determine the nature of the final products. (auth)

45361 CHEMICAL CONSEQUENCES OF THE REACTION $^{127}I(n,\gamma)^{128}I$ IN MIXTURES OF IODINE AND n-BUTANE IN THE GAS PHASE. Lagarde, G.; Abbe, J. Ch.; Paulus, J. M. (Centre de Recherches Nucleaires, Strasbourg). Radiochim. Acta; 17: No. 2, 96-101(Jul 1972). (In French).

Gaseous mixtures of iodine and n-butane were submitted to neutron irradiation. Hot atom reactions yield to the following products: CH_2I_2 (31%), CH_3I (22%), C_2H_5I (21%), C_2H_3I (13%), $n\text{-}C_3H_7I$ (9%) and $s\text{-}C_5H_{11}I$ (4%) with a total organic yield of 1.10%. The results are in good agreement with the kinetic theory of Estrup–Wolfgang and give a calculated reactivity integral I = 0.0071 α_{Ar}. The other reactions arise from excited iodine atoms or ions resulting in the formation of CH_3I (80%) and C_2H_5I (20%) with a total organic yield of 0.94%. This study reveals the importance of decomposition reactions of the primary products. (auth)

45362 CHEMICAL CONSEQUENCES OF THE REACTION $^{127}I(n,\gamma)^{128}I$ IN MIXTURES OF IODINE AND n-BUTANE IN THE LIQUID PHASE. Lagarde, G.; Abbe, J. Ch.; Paulus, J. M. (Centre de Recherches Nucleaires, Strasbourg). Radiochim. Acta; 17: No. 2, 102-4(Jul 1972). (In French).

The total organic yield of ^{128}I produced by radiative neutron capture in solutions of iodine and n-butane is 26% (for an iodine mole fraction of 0.003). The relative abundance of C_4H_9I is 51%. The comparison of these results with those obtained in the gaseous phase reveals an important phase effect. The observed phenomena are interpreted as resulting from the direct interaction between ^{128}I and butane and from the biradical reactions arising from the autoradiolysis of butane. (auth)

45363 ESTRUP–WOLFGANG THEORY OF HOT REACTIONS. PART II. α, THE ENERGY LOSS PARAMETER. Urch, D. S. (Queen Mary Coll., London). Radiochim. Acta; 17: No. 2, 105-10 (Jul 1972).

The possibility is considered that α, the energy loss parameter used in the Estrup–Wolfgang theory of hot reactions, might vary with energy. Calculations by Estrup have shown that α probably is a function of energy. It is shown that only slight variations in α could vitiate the conclusions drawn from the theory as to the relative energies of "hot" atoms that produce particular products. Attempts are made to provide criteria for judging the relative energies of atoms that initiate different reactions. Allowing α to be a function of energy provides an explanation for all the deviations from "classical" kinetic theory behavior that have so far been observed. (auth)

45364 ANNEALING REACTIONS IN POTASSIUM CHROMATE. PART 3. DOPANT-ATOM AND RECOIL-ATOM ANNEALING IN NEARLY IDENTICAL CRYSTALS OF POTASSIUM CHROMATE. Collins, Carol H.; Ackerhalt, Robert E.; Collins, Kenneth E. (State Univ. of New York, Buffalo. Western New York Nuclear Research Center, Buffalo). Radiochim. Acta; 17: No. 2, 73-5 (Jul 1972).

Thermal annealing of ^{51}Cr atoms, introduced into nearly identical K_2CrO_4 crystals as $^{51}Cr(III)$ dopant and as ^{51}Cr recoil atoms, indicates several different categories of annealing reactions. The $^{51}Cr(III)$-dopant atoms and ^{51}Cr recoil atoms anneal at the same rates to identical quantities of $^{51}Cr(VI)$ at temperatures above 150°, indicating that thermal annealing processes in K_2CrO_4 which occur above this temperature are insensitive to the exact structure of the annealable ^{51}Cr sites and reflect rather the properties of the bulk crystals. At intermediate temperatures (0 to 150°), the recoil atoms anneal at faster rates than the dopant atoms while at temperatures below 0°, comparable fractions of dopant atoms and recoil atoms anneal by processes too fast to follow by analysis at 0°. (auth)

Properties of Radioactive Materials

Refer also to abstract: 45313.

45365 (IEA–183) OPTIMIZATION STUDY OF THE PRECIPITATION OF THORIUM OXALATE. Ikuta, A.; Costa, E. C. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Aug 1969. 20p. Dep. NTIS (U. S. Sales Only).

The maximization of the effects of 4 variables (time, temperature, initial free HNO_3 concentration, and excess oxalic acid) on the filtration rate of $Th(C_2O_4)_2 \cdot 6H_2O$ precipitated from a 60g ThO_2/1 thorium nitrate solution was studied. The precipitations were carried out in a batch agitated lab-scale reactor at constant weight of $Th(C_2O_4)_2 \cdot 6H_2O$, while in the filtration step a constant volume was filtered under constant vacuum through filter papers of the same lot. The optimization was effected by the Steepest Ascent Method employing data from a half-replicate of a 2^4 factorial design. A total of 25 tests were required. The analysis of the data indicated that maximum filtration rate for a 60g ThO_2/1 solution is obtained by precipitation at 60 ± 4°C in a 3.1 ± 0.3N HNO_3 solution, using 20 ± 3% excess oxalic acid with a precipitation-digestion period of 28 ± 2 min. A check on these data was obtained by individual parametric variation around the maximum. Solutions containing 40 and 80 g ThO_2/1 were also precipitated at these conditions, however, results indicated the need for optimization at each particular solute concentration level. (auth)

45366 (JINR–P6-6402) STUDY OF TRANSURANIUM ELEMENT HYDROLYSIS. I. STUDY OF HYDROLYSIS BY PARTITION CHROMATOGRAPHY (UO_2^{2+}, PuO_2^{2+}). Korotkin, Yu. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1972. 15p. (In Russian). Dep. NTIS (U. S. Sales Only).

A possibility is considered of application of reverse phase partition chromatography to hydrolysis study. The scheme suggested was tested by studying the hydrolysis of uranyl and plutonyl ions. (auth)

45367 X-RAY PHOTOELECTRON SPECTRA OF URANIUM OXIDES. Chadwick, D.; Graham, J. (Central Electricity Research Labs., Leatherhead, Eng.). Nature (London) Phys. Sci.; 237: No. 77, 127-8(19 Jun 1972).

X-ray photoelectron spectroscopy is an analytical technique that may prove useful in ascertaining the oxidation state of U in particular environments, and an examination was made of the spectra of UO_2, U_3O_8, and UO_3, as well as of U metal. Details are given of the experimental technique, and the basis of the method, and results are shown tabulated. The measurements indicated a chemical shift of 1 to 1.2 eV between the 4f core levels in UO_3 and UO_2. The observed shift between UO_2 and U_3O_8 was probably just significant (0.4 eV), although the 4f binding energies for U_3O_8 are distinctly different from those for UO_3. The binding energies observed to increase from UO_2 through U_3O_8 were probably just as significant (0.4 eV), although the 4f binding energies for U_3O_8 are distinctly different from those for UO_3. The binding energies were observed to increase from UO_2 through U_3O_8 to UO_3, which is to be expected on the basis of the increase in the formal U oxidation state from $UO_2[U_{(IV)}]$ to $UO_3[U_{(VI)}]$. At room temperature U_3O_8, supposedly a mixed valence state compound, gave only single peaks with a line width comparable with the other oxides. Results for oxide-coated U metal indicated that the crating has a stoichiometry close to UO_2. Some interesting observations on abrasively cleaned metal are mentioned. (UK)

45368 DETERMINATION OF THE STRUCTURE OF MONOHYDRATED URANYL DIFORMATE USING X-RAY DIFFRACTION. Claudel, Bernard; Mentzen, Bernard; Navarro, Alain; Puaux, J. P. (Institut National des Sciences Appliquees, Villeurbanne, France). Compt. Rend., Ser. C; 274: No. 16, 1417-19 (17 Apr 1972). (In French).

Monohydrated uranyl diformate crystallizes in a formic acid medium as crystals having an orthorhombic symmetry. The x-ray diffraction patterns of monocrystals and powders were studied. The lattice was confirmed to be orthorhombic with the following lattice parameters: a = 5.84 ± 0.01A; b = 11.55 ± 0.02A; c = 19.40 ± 0.04A; the space group being F ddd. (France)

45369 IONIC SOLVATION NUMBERS FROM COMPRESSIBILITIES AND IONIC VIBRATION POTENTIALS MEASUREMENTS. Bockris, J. O'M.; Saluja, P. P. S. (Univ. of Pennsylvania, Philadelphia). J. Phys. Chem.; 76: No. 15, 2140-51(20 Jul 1972).

Results are presented of work the general aim of which is to extend and deepen the model of the solvent sheath near ions in aqueous solutions. The experimental measurements reported are those of the compressibility of the solution. A modification of the method reported previously was used to give sound velocity at frequency of 5 MHz to an accuracy of ± 0.4 m sec^{-1}. The velocity measurements are converted into values of the compressibility, β, by the use of a well-known equation. Such measurements are then converted by the equation of Passynski into solvation numbers. It is desired to obtain solvation numbers. Ionic vibration potentials due to Madan and to Zana and Yeager were utilized. These give the difference of the masses of the ions of a salt, together with the water molecules which move with the ions when they receive an ultrasonic pulse. The individual solvation numbers were found to be Li^+ = 4.0, Na^+ = 4.5, K^+ = 3.5, Rb^+ = 3.0, Cs^+ = 2.5; Ba^{2+} = 11.0, Ca^{2+} = 9.0, Sr^{2+} = 9.0, Mg^{2+} = 10.0; La^{3+} = 15.0, Ce^{3+} = 18.0, Th^{4+} = 22.0, F^- = 4.0, Cl^- = 2.0, Br^- = 1.8, and I^- = 1.5. A theoretical discussion of the meaning of the compressibility and ionic vibration potential measurements is given. It is stressed that the discussion is made on the basis of a definition of solvation number (SN). It will be noted that this solvation number definition is time dependent. Correspondingly, a relationship between the reorientation time of the solvent and the time during which the ion waits in its movement in solution is shown and supports the definition given. An argument is given, which suggests that the compressibility and the ionic vibration potential measurements measure the same quantity. (auth)

45370 PRECIPITATION OF SOME ACTINIDE ELEMENT COMPLEX IONS BY USING HEXAMMINE COBALT(III) CATION. IV. THE PRECIPITATION OF URANIUM(VI) PEROXO COMPLEX ION WITH HEXAMMINE COBALT(III) ION. Hoshi, Michio; Ueno, Kaoru (Japan Atomic Energy Research Inst., Tokai). J. Inorg. Nucl. Chem.; 34: No. 7, 2277-82(Jul 1972).

The precipitation behaviors of uranium(VI) peroxo complex ion were investigated with hexamminecobalt(III) cation. This precipitation reaction produces $[Co(NH_3)_6]_4[(UO_2)_2(O_2)_4]_3\ nH_2O$, which changes to monoperoxo species by hydrolysis in water. Monoperoxo species i.e. $[Co(NH_3)_6]_4[(UO_2)_2(O_2)_2(OH)_4]_3 12H_2O$ belongs to a tetragonal system with a = 7.18 Å and c = 13.02 Å. (auth)

45371 PROCESS FOR RECOVERING BY-PRODUCTS FROM URANIUM DIOXIDE PRODUCTION. Pirk, H.; Muller, H.; Hackstein, K. (to NUKEM-Nuklear-Chemie und Metallurgie Gesellschaft mbH). Canadian Patent 891,958. 1 Feb 1972. Priority date 23 Apr 1969, Germany.

A process is described for the recovery of uranium, ammonium hydrogen fluoride, ammonia, carbon dioxide, and water from the filtrates and waste gases resulting from the conversion of uranium hexafluoride to uranium dioxide by the precipitation of the uranium as tetraammonium uranyl tricarbonate (AUC) and the associated reductive pyrohydrolysis of this salt. (Canada)

45372 EPR STUDY OF VO^{2+} IN $UO_2(NO_3)_2$ X $6H_2O$ SINGLE CRYSTAL. Krishnamurthy, M. V. (Bhabha Atomic Research Centre, Trombay, India). J. Phys. Chem. Solids; 33: No. 8, 1645-9(Aug 1972).

The electron paramagnetic resonance of VO^{2+} ion doped in uranyl nitrate hexahydrate single crystals was studied. The room temperature studies show that the VO^{2+} ion undergoes rapid reorientation or hindered motion in the crystal lattice. These motions are effectively quenched at liquid nitrogen temperature. The low temperature studies reveal that the V–O axis of the vanadyl ion is randomly oriented in the lattice and this randomness gives rise to the observed powder spectrum. The line-widths of the hyperfine lines at room temperature are found to depend on the nuclear quantum number, m_I. This line-width variation is satisfactorily explained employing McConnell–Kivelson theory based on the model of a rapid tumbling paramagnetic complex. (auth)

45373 THORIUM–ACETATE AND THORIUM–PROPIONATE COMPLEXES. Tedesco, P. H.; Anon, M. C. (Univ. Nacional, La Plata). J. Inorg. Nucl. Chem.; 34: No. 7, 2271-6(Jul 1972).

Equilibrium of complexes formation was studied for the systems thorium–acetate and thorium–propionate at 25°C and ionic strength 1.0. At the experimental conditions only the first stability constant was possible to determine, using the potentiometric and spectrophotometric methods, which gave results in good agreement. (auth)

45374 STUDY ON CATALYSIS OF URANIUM OXIDE AND ITS MIXED CATALYSTS. II. STRUCTURE OF URANIUM–ANTIMONY OXIDE CATALYST AND CATALYTIC ACTIVITY FOR OXIDATION OF PROPYLENE TO ACROLEIN. Nozaki, Fumio; Okada, Hiroshi (Chiba Univ., Japan). Nippon Kagaku Kaishi; No. 5, 842-9(May 1972). (In Japanese).

A uranium antimony oxide catalyst, claimed in the patents for the oxidation of propylene to acrolein, was investigated from a standpoint of structure and activity relationships. Catalytic activity tests were carried out by a flow system and a pulse reaction method. X-ray pattern, D.T.A.-T.G.A. curve and low frequency infrared spectrum of the U–Sb binary oxide catalyst system were measured for characterizing the catalyst structure. The following conclusions were obtained. (1) High selectivity of propylene to acrolein in excess of 70% was achieved over the catalysts with a lower atomic U/Sb ratio than 4/6 and those calcined at high temperatures above 700°C. (2) The formation of the double oxide (USb_3O_{10}) was observed by calcination at about 620°C. On the basis of direct relationship between a calcination temperature above 700°C and appearance of catalytic activity for selective acrolein formation, USb_3O_{10} was recognized as the active component of the catalyst. (3) From the experiments on reducing the catalyst with propylene pulses and reoxidizing the catalyst with oxygen pulses, interesting information on the catalysis was obtained. (auth)

45375 EXISTENCE OF REGULARITIES, TETRAD, OR DOUBLE–DOUBLE EFFECT IN THE CHANGES IN UNIT CELL VOLUMES OF THE COMPOUNDS OF THE ACTINIDES IN DIFFERENT OXIDATION STATES. Siekierski, S.; Fidelis, I. (Inst. of Nuclear Research, Warsaw). J. Inorg. Nucl. Chem.; 34: No. 7, 2225-31(Jul 1972).

It is shown that the contraction of the actinides as measured by the changes with atomic number, Z, of the unit cell volumes of their compounds in the +3, +4, and +6 oxidation states, shows the same double–double effect (regularities, or tetrad effect) as that observed in the case of the lanthanides. (auth)

45376 IDENTIFICATION OF AN $AmCl_6^{3-}$ OCTAHEDRAL COMPLEX FROM THE Am(III) ABSORPTION SPECTRUM IN ETHANOL SOLUTIONS OF HCl. Barbanel, Yu. A.; Kotlin, V. P.; Gorskii, A. G. Dokl. Akad. Nauk SSSR; 202: No. 4, 830-3(1 Feb 1972). (In Russian).

At certain concentrations of HCl in ethanol solutions of Am (III) a spectrum was obtained, which was used to assign an octahedral configuration to the americium present. Additional work with Pr(III) and Nd(III) aided in the substantiation of the spectroscopic identification of a $AmCl_6^{3-}$ complex, and in confirming the existence of the set of complexes $LnCl_6^{3-}$. (K.S.W.)

45377 CHEMICAL SHIFTS IN THE $L_{\alpha 1}$ X-RAY LINE OF SOME URANIUM COMPOUNDS. Vdovenko, V. M.; Makarov, L. L.; Suglobova, I. G.; Volkov, V. A.; Chibisov, N. P. (Leningrad State Univ.). Dokl. Akad. Nauk SSSR; 202: No. 4, 868-70(1 Feb. 1972). (In Russian)

Chemical shifts in the L_α line of U for a series of chlorine- and oxygen-containing compounds were obtained: for example in the pairs $CsUCl_5$–UCl_4, Cs_2UCl_6–UCl_4, UCl_3–UO_3, K_2UCl_6–Rb_2UCl_6, and UO_2–U, shifts accompanying the change in chemical state of the U amounted to as much as ~1 eV. These shifts are ascribed to a participation of the 5f electrons in the electron structure of U. (K.S.W.)

45378 U_2X_5 TYPE SULFIDES AND SELENIDES OF U AND Ca, Sr, Ba, Pb, AND Eu(X = S, Se). Brochu, Robert; Padiou, Jean; Prigent, Jacques (Univ., Rennes, France). Compt. Rend., Ser. C; 274: No. 10, 959-61(6 Mar 1972). (In French).

MU_2S_5 (M = Pb, Eu) and MU_2Se_5 (M = Ca, Sr, Ba, Pb, Eu) were synthesized. Studies on monocrystals of PbU_2X_5 (X = S, Se) confirm the orthorhombic cell with the probable $P2_122_1$ space group. The structural similarities between U_2Se_5 and MU_2Se_5 are confirmed by the existence of continuous solid solutions: $M_xU_{(3-x)}Se_5$ ($0 \leq x \leq 1$). (France)

45379 FLUORINATION OF UO_2 AND U_3O_8 BY GASEOUS BROMINE TRIFLUORIDE. Iwasaki, M.; Sakurai, T. (Japan Atomic Energy Research Inst., Tokai). J. Inorg. Nucl. Chem.; 34: No. 7, 2189-2200(Jul 1972).

The reactions of UO_2 and U_3O_8 with gaseous BrF_3 were studied gravimetrically. The specimens of uranium oxides were in pelletized form. The kinetic equations were determined as follows: $k[g/cm^2 \cdot h] = 0.346 \exp(-3900/RT)p$ for UO_2, $k[g/cm^2 \cdot h] = 0.024 \exp(-950/RT)p$ for U_3O_8. The activation energies were 3.9 and 0.95 kcal/mole for UO_2 and U_3O_8, respectively. A little amount of solid intermediate was formed for both oxides. Their chemical form, however, was not identified. The reaction process was discussed by considering the chemical behavior of BrF_3. (auth)

45380 COUPLING SCHEME IN URANYL COMPLEXES. Goerller-Walrand, C.; Vanquickenborne, L. G. (Univ. Leuven, Heverlee, Belg.). J. Chem. Phys.; 57: No. 4, 1436-40(15 Aug 1972).

Simple theoretical considerations of the ligand field type were applied to the electronic structure of insular uranyl complexes. The study of the consequences of equatorial ligation is used as a means to test the applicability of different coupling schemes for the isolated uranyl ion. From the analysis of the spectra of a large number of different uranyl complexes of D_{nh} symmetry, it was previously shown how the effect of equatorial ligation consists in lifting certain degeneracies of the free uranyl electronic energy levels and introducing variations in the corresponding transition probabilities. In this note the equatorial field operator is successively applied to uranyl wavefunctions derived in a Russell–Saunders approximation, in an $\omega-\omega$ coupling approximation, and in an intermediate scheme. Only Russell–Saunders coupling allows a satisfactory explanation of the observed splitting and intensity pattern. (auth)

Radioactive Waste Treatment

Refer also to abstracts: 45190 and 46098.

45381 (ARH-SA-120) PHOSPHATE SOLIDIFICATION OF CAUSTIC PROCESS SOLUTION WASTE. Puryear, Dean A.; Buckingham, J. Steve; Campbell, Milton H. (Atlantic Richfield Hanford Co., Richland, Wash.). May 1972. Contract AT(45-1)-2130. 14p. (CONF-720628-2). Dep. NTIS.

From twenty-seventh ACS northwest regional meeting; Corvallis, OR. (15 Jun 1972).

A process for solidifying concentrated high-salt process solution waste with phosphoric acid is investigated on a laboratory-scale. Discussion of the proposed application of this process is presented, as well as the tests and results used to establish the parameters for solidification candidates. Synthetic high-salt caustic wastes are used to accumulate data on the kinetics of the reaction. The product is postulated to be the chemical complex $7(Na_3PO_4 \cdot 12H_2O)NaOH$ or a derivative thereof. Quality of the product is directly related to wt % water, total sodium molarity, and the amount of monovalent sodium salt present in the waste candidate. (auth)

45382 (ARH-SA-130) PLUTONIUM–URANIUM PARTITIONING BY A REFLUX SOLVENT EXTRACTION FLOWSHEET. Bruns, L. E. (Atlantic Richfield Hanford Co., Richland, Wash.). 4 May 1972. 22p. (CONF-720607-19). Dep. NTIS.

From eighteenth annual American Nuclear Society conference; Las Vegas, NV. (18 Jun 1972).

A solvent extraction flowsheet was developed for the processing of unirradiated plutonium–uranium scrap. By refluxing plutonium product as plutonium(III) in a multistage plutonium stripping-partitioning system, uranium is salted into the organic and pure plutonium is quantitatively separated from uranium. A hydrofluoric acid strip removes the final traces of plutonium from the organic phase containing the uranium. The flowsheet was plant-tested; and problems evident in the plant test were solved by comprehensive laboratory tests. Plant flowsheets were successfully tried; further laboratory tests were made to enhance column control. (auth)

45383 (ICP-1008) DTA-X-RAY DIFFRACTION EXAMINATION OF CHEMICAL REPROCESSING WASTES CONTAINING SODIUM AND POTASSIUM NITRATES. Newby, B. J.; Dickerson, Edwarda S. (Allied Chemical Corp., Idaho Falls, Idaho). Apr 1972. Contract AT(10-1)-1375. 32p. Dep. NTIS.

Sodium and potassium nitrates pose problems in fluidized-bed calcination; the large temperature range over which the nitrates exist in the molten-undecomposed state makes the fluidized-bed prone to agglomeration. Differential thermal analyses combined with x-ray diffraction were used to scope methods for lowering the decomposition temperature of sodium and potassium nitrates in wastes. The decomposition temperature of sodium nitrate in wastes can be lowered effectively by adding alumina, aluminum nitrate, sulfuric acid, ammonium sulfate, or magnesium sulfate. The same reagents are potential reagents for lowering the decomposition temperature of potassium nitrate in wastes. (auth)

45384 METHOD OF DECONTAMINATING CESIUM. Berton, Yves; Chauvet, Paul; des Ligneris, Jean (to Commissariat a l'-Energies Atomique). French Patent 2,067,743. 26 Jul 1971. Filed 14 Nov 1969. (In French).

A method for decontaminating Cs, applicable to the decontamination of effluents arising from the processing of irradiated nuclear fuels, is described. The method involves the preparation of a colloidal nickel ferrocyanide suspension and the addition of this suspension to the effluent (at a pH not exceeding 11). This ratio of the Ni and ferrocyanide ion concentrations in the colloidal suspension is less than 1.5. (France)

45385 ESTER PROGRAM: HIGH-LEVEL RADIOACTIVE WASTE SOLIDIFICATION. BENCH-SCALE PHOSPHATE GLASS VITRIFICATION TESTS WITH SIMULATED FISSION PRODUCT SOLUTIONS. Bocola, W.; Donato, A. (CNEN, Rome). Energ. Nucl. (Milan); 19: No. 6, 390-401(Jun 1972).

The ESTER Program, carried out by the Casaccia Center of CNEN, is aimed at contributing to the solution of problems of treatment and disposal of high-level radioactive wastes resulting from nuclear fuel reprocessing. The process studied in the frame of this program is the fixation of fission product solutions in stable and insoluble glasses. Results and the practical experience achieved from twenty-seven phosphate glass vitrification runs, carried out in a bench-scale plant with six different types of simulated fission product solutions are described. The solids produced, containing 2 to 16% in moles and 4 to 22 wt % of fission product oxides, are of the glassy type and in some cases of ceramic type. Their leaching rates, determined at 25°C in distilled water, are 10^{-6} g $cm^{-2}d^{-1}$. Ruthenium volatilization is lower than 0.75% when red phosphorus is used as a glass former additive, but higher in the case of phosphoric acid. (auth)

45386 METHOD OF DISPOSING OF RADIOACTIVE ORGANIC WASTE SOLUTIONS. Knoll, Kenneth C. (to United States Atomic Energy Commission). U. S. Patent 3,666,673. 30 May 1972. Filed 24 Dec 1969.

Radioactive organic waste solutions may be disposed of and the radioactive material contained therein may be concentrated by passing the wastes as a liquid or vapor into a suitable preheated oxidation catalyst in the presence of air and collecting the radioactive residue from the oxidized organic wastes. (Official Gazette)

45387 SYSTEM FOR TOTAL IODINE RETENTION. Maeck, William J. (to United States Atomic Energy Commission). U. S. Patent 3,658,467. 25 Apr 1972. Filed 28 Jul 1969.

A method of absorbing and retaining air-borne inorganic iodine and organic iodine species by passing a gaseous stream containing these iodines through a filter bed of synthetic zeolite in a metal ion-exchanged form, which metal is reactive with iodine, is described. (Official Gazette)

45388 MODIFIED MACROPOROUS STYRENE–DIVINYLBENZENE COPOLYMERS AS THE SORBENTS WITH SELF-FIXATION ABILITY FOR THE REMOVAL OF VAPORS OF RADIOIODINE AND ITS COMPOUNDS. PART I. EQUILIBRIUM SORPTION OF METHYL IODIDE VAPORS ON NONMODIFIED MACROPOROUS STYRENE–DIVINYLBENZENE COPOLYMERS. Cejnar, Frantisek (Ustav Jaderneho Vyzkumu, Rez, Czech.). Jad. Energ.; 18: No. 6, 199-200(Jun 1972). (In Czech).

Sorption and desorption isotherms were obtained for fission product iodine as methyl iodide on nonmodified macropous styrene–divinylbenzene copolymers. The effects of various percentages of divinylbenzene on the sorption were studied. (M.C.G.)

45389 SORPTION OF POLYVALENT ELEMENTS ON SILICA GEL. II. SORPTION OF PROTACTINIUM ON SILICA GEL FROM MIXED AQUEOUS-ORGANIC SOLUTIONS OF HCl AND HNO_3. Caletka, R. (Nuclear Research Inst., Rez, Czech.). Collect. Czech. Chem. Commun.; 37: No. 5, 1494-1503(May 1972).

The effect of methanol, ethanol, 1-propanol, 2-propanol, acetone, and dioxane on the sorption of protactinium on silica gel was studied. It was found that in the presenee of these solvents the sorption of protactinium decreases and the sorption kinetics are slower. The values of the distribution coefficients depend not only on the composition of the solution but, in several cases, also on its age. The sorption kinetics are mainly governed by the structure of silica gel. The effect of alcohols on the sorption of protactinium increases with the increasing number of carbon atoms in the alcohol molecule. The results are explained by the formation of ionic associates. The associates in solutions with the concentrated hydrochloric acid have the probable formula $[SH(H_2O)_n \cdot S]_{x-5} \cdot PaCl_x$ (where S denotes the organic solvent molecule and x = 6 to 8). In the case of acetone and dioxane, the formation of the well-sorbed associates $(SH \cdot H_2O)_{x-5} \cdot PaCl_x$ is assumed. The sorption of protactinium from the hydrochloric and nitric acid

solutions in the presence of methanol and ethanol is compared. (auth)

45390 SORPTION OF POLYVALENT ELEMENTS ON SILICA GEL. III. ISOLATION OF PROTACTINIUM BY SORPTION ON SILICA GEL FROM THE SOLUTIONS OF HCl and H_2SO_4. Caletka, R. (Nuclear Research Inst., Rez, Czech.). Collect. Czech. Chem. Commun.; 37: No. 5, 1684-9(May 1972).

The sorption of trace amounts of protactinium on silica gel was studied under dynamic conditions together with the desorption effectiveness of various aqueous and aqueous–organic solutions. The possibility to separate protactinium, zirconium, hafnium, and niobium in the hydrochloric or sulfuric acid solutions was proved experimentally. Protactinium was also separated from the activated thorium salts and from the uranium ore. The mixture of 30% of 11.5M-HCl and 70% of 2-propanol or 10M-H_2SO_4 can be used for the elution of protactinium adsorbed on the column of silica gel. (auth)

45391 SORPTION OF POLYVALENT ELEMENTS ON SILICA GEL. IV. SEPARATION OF THE TETRAVALENT AND PENTAVALENT PROTACTINIUM. Caletka, R.; Knobloch, V. (Nuclear Research Inst., Rez, Czech.). Collect. Czech. Chem. Commun.; 37: No. 5, 1690-2(May 1972).

The possibility of the tetravalent and pentavalent protactinium separation on silica gel was studied and it was found that in the presence of hydrochloric and sulfuric acids the protactinium adsorbed on the silica gel column is reduced and washed out by chromium(II) solutions whereas the nonreduced fraction of protactinium remains adsorbed on the column. The method was tested with trace amounts of the ^{233}Pa nuclide. It was found that under similar conditions the elution of niobium from silica gel proceeds only partly. (auth)

Radioisotope Production

Refer also to abstracts: 45223 and 45260.

45392 (N–72-15068) CYCLOTRON PRODUCTION OF ^{123}I: AN EVALUATION OF THE NUCLEAR REACTIONS WHICH PRODUCE THIS ISOTOPE. Sodd, Vincent J.; Scholz, Kenneth L.; Blue, James W.; Wellman, Henry N. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Oct 1970. 45p. (NASA-TM-X-67594; BRH/DMRE-70-4). NTIS.

Various nuclear reactions are described by which ^{123}I, a low radiation dose radiopharmaceutical, can be cyclotron-produced. Methods of directly producing ^{123}I and those that indirectly produce the radionuclide through the beta (+) decay of its natural precursor, ^{123}Xe. It is impossible to separate the radioiodine contaminants that occur in the direct method. Thus, it is preferable to produce pure ^{123}I from ^{123}Xe, which is easily separated from the radioiodines. Among the characteristics of ^{123}I is the capability of reducing the patient dose in a thyroid uptake measurement to a very small percentage of that delivered by the more commonly used ^{131}I. (auth) (STAR)

45393 CONVERSION OF CALIFORNIUM α-HYDROXYISOBUTYRATE TO OXIDE WITH CARBOXYLIC ACID RESIN. Harbour, R. M.; Hale, W. H. Jr. (E. I. duPont de Nemours and Co., Aiken, S. C.). Radiochem. Radioanal. Lett.; 10: No. 6, 339-44 (15 Jul 1972).

A method was developed to recover ^{252}Cf from ion exchange product solutions and prepare $^{252}Cf_2O_3$. The process was demonstrated with ^{252}Cf tracer and bulk neodymium stand-in; an ammonium α-hydroxyisobutyrate-Nd–Cf solution was adjusted to pH 9, Nd–Cf was sorbed on carboxylic acid resin, and the oxide was prepared by calcination at 600°C. (auth)

45394 PRODUCTION OF CARRIER-FREE ^{54}Mn BY THE α-PARTICLE BOMBARDMENT OF NATURAL CHROMIUM. Akiha, Fumimasa (Hirosaki Univ., Japan); Yuita, Koichi; Aburai, Tamaru; Nozaki, Tadashi; Murakami, Yukio. Nippon Kagaku Kaishi; No. 5, 908-13(May 1972). (In Japanese).

For the production of ^{54}Mn by the α- and ^{3}He-particle reactions on natural chromium, their excitation curves and thick-target yields were measured. Various conditions in the production procedure, especially the chemical separation of manganese in a hydrochloric acid solution of the bombarded target after the removal of ^{52}Fe were examined. A stack of thin chromium plates was bombarded by a beam of α- or ^{3}He-particles of 44-MeV maximum energy, and the manganese activities were measured nondestructively or after the chemical separation. The excitation curve of the α-reaction shows a maximum of 490 mb near 30-MeV energy, and that of the ^{3}He-reaction, a maximum of 80 mb near 18-MeV. The thick-target yields for 40-MeV incident energy are 6 μCi/μAhr and 1.1 μCi/μAhr for the α reaction and the ^{3}He reaction, respectively. The α reaction thus proved to give a higher yield of ^{54}Mn than the other possible reactions. The bombarded chromium target was dissolved in a hydrochloric acid solution (8N) from which the ^{52}Fe was removed by an extraction method. The remaining solution was saturated with pure HCl gas by bubbling it through the solution, from which almost all the nonradioactive chromium and other active contaminants were removed by an anion exchange method. The manganese solution thus obtained was evaporated to dryness, and the Cl^--free residue was dissolved in 50 ml of 10 mol/l H_2SO_4 together with 2g of KIO_3. Then the Mn was distilled out as Mn_2O_7 from the resulting solution into a trap containing a small amount of dilute HCl solution plus H_2O_2. To maintain the solution at 10 mol/l of sulfuric acid concentration and 166°C, which is the optimum condition for distillation, azeotropic nitric acid vapor (120.5°C) was added gradually to the boiling solution. The ^{54}Mn was obtained in a carrier-free state. The chemical yields over all the chemical procedure proved to be >90% with a sufficient radiochemical purity. (auth)

45395 PRODUCTION OF CARRIER-FREE ^{197m,197}Hg WITH A CYCLOTRON. Wilkniss, P. E.; Beach, L. A.; Marlow, K. W. (Naval Research Lab., Washington, D. C.). Radiochim. Acta; 17: No. 2, 110-13(Jul 1972).

The practical aspects of the production of carrier-free mercury in a cyclotron by proton bombardment of a gold target are discussed. A liquid nitrogen cooled target assembly and the radiochemical procedure for the recovery of carrier-free mercury from the gold target are described. Gamma spectra obtained with a Ge(Li) detector and a Si(Li) detector are shown. Experimental yield determinations for ^{197m,197}Hg are compared with theoretical calculations. (auth)

45396 UTILIZATION OF RESEARCH REACTORS FOR RADIOISOTOPE PRODUCTION. Rahman, M. Matiur (Pakistan Inst. of Nuclear Science and Tech., Rawalpindi). Nucleus (Karachi); 8: No. 4, 29-32(1971).

The radioisotope production facility at the Pakistan Institute of Nuclear Science and Technology (PINSTECH) is described. It is suggested that efforts should be directed towards the establishment of methods for the selection of target materials and the determination of chemical processes for production. Besides, some basic research on nuclear reactions and the chemical effects of nuclear transformation is also vital for radioisotope production, to say nothing of the guaranteeing of high radiochemical purity for the products, procedures of activation analysis of target materials, etc. (auth)

Reactor Fuel Reprocessing

Refer also to abstracts: 45308 and 47300.

45397 (CONF-720903–9) CONTINUOUS OR SEMICONTINUOUS LEACHER FOR LEACHING SOLUBLE CORE MATERIAL FROM SHEARED SPENT NUCLEAR FUEL TUBES. Odom, C. H. (Oak Ridge National Lab., Tenn.). 1972. 32p. Dep. NTIS.

From twentieth remote systems technology conference; Idaho Falls, ID. (17 Sep 1972).

The effective dissolution of sheared liquid-metal fast breeder reactor fuels is considered. Concepts and models representative of current approaches to the continuous or semicontinuous dissolution of these fuels were developed to assess the magnitude of the difficulties to be encountered in controlling the flow, residence time, agitation, and transfer of the sheared material through such a device. The performance of many of the models developed was successfully demonstrated, but the model of the compartmented rotary drum continuous leacher with sloped transfer ducts is representative of the most effective and straightforward design required to meet all of the performance requirements. (auth)

45398 (DOCKET-50201-125) WEST VALLEY REPROCESSING PLANT. Quarterly Report for April 1, 1972–June 30, 1972, Part I. (Nuclear Fuel Services, Inc., West Valley, N. Y.). 14 Jul 1972. 8p. Dep. NTIS.

Environmental samples were analyzed for ^{131}I, alpha activity, and beta activity. Total discharges in liquid and gaseous effluents are given for gross α, gross β, tritium, ^{90}Sr, ^{129}I, ^{85}Kr, and ^{131}I. Surveillance tests and filter replacements are listed. (M.C.G.)

45399 (DOCKET-50201-126) WEST VALLEY REPROCESSING PLANT. Technical Specifications, Request for Approval of Revisions. (Nuclear Fuel Services, Inc., Rockville, Md.). 19 Jul 1972. 48p. Dep. NTIS.

Revisions are requested for technical specifications for: form of materials, extractant concentration, plutonium ion exchange operation, caustic concentration in carbon steel waste storage tanks, solid radioactive waste burial, evaporator steam pressure, respiratory protection equipment, process instrumentation, high

radiation area access, contamination and radiation control, slump alarms and eductors, dissolver dilution air, boric acid, and solvent analysis. (M.C.G.)

45400 (DOCKET-50201-127) WEST VALLEY REPROCESSING PLANT. Low Level Waste Disposal. (Nuclear Fuel Services, Inc., Rockville, Md.). 21 Jul 1972. 2p. Dep. NTIS.

Lagoon No. 3 was scraped clean of settled contamination and transfers to it will be from Lagoons 4 and 5, which receive discharge from the Low Level Waste Treatment facility. Piping was installed between holding lagoons at the solid waste burial site and the feed lagoon for the Low Level Liquid Waste Treatment plant. (M.C.G.)

45401 (DOCKET-50201-128) WEST VALLEY REPROCESSING PLANT. Comments Concerning Nuclear Criticality. (Directorate of Licensing (AEC), Washington, D. C.). 8 Aug 1972. 3p. Dep. NTIS.

Criticality in the proposed intercycle evaporators and plutonium solvent extraction system is considered. (M.C.G.)

45402 (DOCKET-50268-31) MIDWEST FUEL RECOVERY PLANT. Notice of Consideration of Issuance of a Facility Operating License and Notice of Opportunity for Hearing. (Directorate of Licensing (AEC), Washington, D. C.). 1 Aug 1972. 5p. Dep. NTIS.

45403 (DOCKET-50268-32) MIDWEST FUEL RECOVERY PLANT. Final Safety Analysis Report, Amendment 27. (General Electric Co., San Jose, Calif. Nuclear Fuel Dept.). 9 Aug 1972. 5p. Dep. NTIS.

An amendment is submitted for requesting temporary use of the service steam system to supply process steam during uranium cold run testing. The change is required because of the failure of the original process supply steam generator. Safety precautions that will be taken are listed. (M.C.G.)

45404 (DOCKET-50268-33) MIDWEST FUEL RECOVERY PLANT. Final Safety Analysis Report, Amendment 28. (General Electric Co., San Jose, Calif. Nuclear Fuel Dept.). 8 Aug 1972. 6p. Dep. NTIS.

A proposal is submitted for operation of the Wiped Film Evaporation System prior to commencement of normal plant operations. It is designed to concentrate wastes in the low-activity waste vault by evaporating their water content. (M.C.G.)

45405 (ICP-1006) IDAHO CHEMICAL PROGRAMS ANNUAL TECHNICAL REPORT, FISCAL YEAR 1971. Bower, J. R. (ed.) (Allied Chemical Corp., Idaho Falls, Idaho. Idaho Chemical Programs Operations Office). May 1972. Contract AT(10-1)-1375. 82p. Dep. NTIS.

The operating experience in fuel processing, waste calcining, and other waste management activities at the ICPP for FY 1971 is summarized. Processing of zirconium fuels was highly satisfactory, and successful startup and operation of a fluidized-bed denitration process for conversion of product uranyl nitrate to UO_3 was achieved. The first campaign for fluid-bed calcination of reactor fuel wastes using in-bed combustion of fuel oil to supply heat was completed with 100% on-stream time and at an increased processing rate over the original WCF (Waste Calcining Facility) system. Technical support activities in areas of current and proposed operations at the ICPP are also presented. These include: corrosion studies on processing equipment and fuel storage facilities; modifications to ICPP processes; developments in the electrolytic-dissolution process; developments in the combustion-dissolution process for graphite fuels; plans for future fuel storage; pilot-plant calcination of varied waste solutions; plans for improved environmental protection at the ICPP. Research programs in other areas include: safeguards in uranium accountability; burnup determination for fast breeder reactor fuels; iodine behavior and iodine adsorbents; ion-control membranes for separations processes. (auth)

45406 (ORNL-TM-2871) LMFBR FUEL CYCLE STUDIES PROGRESS REPORT FOR JANUARY 1970, NO. 11. (Oak Ridge National Lab., Tenn.). Feb 1970. Contract W-7405-eng-26. 102p. Dep. NTIS.

This report continues a series outlining progress in the development of methods for the reprocessing and fabrication of LMFBR fuels. Development work is reported on problems of irradiated fuel transport to the processing facility, the dissolution of the fuel and the chemical recovery of the PuO_2–UO_2 values, the containment of volatile fission products, product purification, preparation of fuel material by the sol-gel process, conversion of fuel processing plant product nitrate solutions to solids suitable for shipping and for fuel fabrication, fuel fabrication of sol-gel materials, and fuel evaluation studies, both in-pile and out-of-pile. Pertinent experimental results are presented for the information of those immediately concerned with the field. Detailed description of experimental work and data are included in topical reports and in the Chemical Technology Division and Metals and Ceramics Division Annual Reports. (auth)

45407 (ORNL-TM-2918) LMFBR FUEL CYCLE STUDIES PROGRESS REPORT FOR FEBRUARY 1970, NO. 12. (Oak Ridge National Lab., Tenn.). Mar 1970. Contract W-7405-eng-26. 89p. Dep. NTIS.

FISSION PRODUCTS—chemistry in oxide fuel dissolution
IODINE—chemistry in oxide fuel dissolution
—volatilization from nitric acid solutions
—separation from fuel reprocessing off-gases by sorption on zeolites or mercury nitrates
LIQUID METAL FAST BREEDER REACTOR—fuel cycle development studies (Feb. 1970) on
METHANE, IODO-—separation from fuel reprocessing off-gases by sorption on zeolites or mercury nitrates
PHOSPHORIC ACID, TRIBUTYL ESTER—stability in Purex Process
PLUTONIUM—purification in Purex Process
—shipping costs for
PLUTONIUM OXIDES PuO_2—production of sinterable powders of, from fuel reprocessing solutions
—PuO_2–UO_2, preparation of sols of
—PuO_2–UO_2, preparation by sol-gel process
—PuO_2–UO_2, fabrication of sol-gel-derived
PUREX PROCESS—solvent stability in
REACTOR FUEL ELEMENTS—shipment of spent LMFBR, criticality and heat dissipation studies on
—reprocessing of stainless steel-clad oxide, shearing studies in
REACTOR FUELS—reprocessing of LMFBR, research progress (Feb. 1970) on aqueous
—performance studies on oxide
TRANSURANIUM PROCESSING PLANT—iodine evolution from dissolver solutions in
URANIUM OXIDES UO_2—production of sinterable powders of, from fuel reprocessing solutions
—preparation of sols of, CUSP process for
—PuO_2–UO_2, preparation of sols of
—PuO_2–UO_2, preparation by sol-gel process
—PuO_2–UO_2, fabrication of sol-gel-derived
WEST VALLEY PROCESSING PLANT—evaluation for handling LMFBR fuels (M.C.G.)

45408 (ORNL-TM-2949) LMFBR FUEL CYCLE STUDIES PROGRESS REPORT FOR MARCH 1970, NO. 13. (Oak Ridge National Lab., Tenn.). Apr 1970. Contract W-7405-eng-26. 97p. Dep. NTIS.

CARBON—reactions with nitrogen and uranium dioxide
FISSION PRODUCTS—solubility in nitric acid
FORMIC ACID—reactions with plutonium dioxide sols
IODINE—volatilization from spent oxide fuels in nitric acid dissolution
—separation from off-gases in LMFBR fuel reprocessing
—chemistry in acidic and alkaline solutions
LIQUID METAL FAST BREEDER REACTOR—fuel cycle development studies (March 1970) on
METHANE, IODO-—separation from off-gases in LMFBR fuel reprocessing
NEUTRONS—effects on plutonium dioxide-uranium dioxide fuels
NITROGEN—reactions with carbon and uranium dioxide
PLUTONIUM OXIDES PuO_2—PuO_2–UO_2, dissolution of irradiated, in nitric acid
—preparation from fuel reprocessing solutions, evaluation of processes for
—PuO_2–UO_2, preparation by sol-gel process
—reactions of sols of, with formic acid
—PuO_2–UO_2, preparation of microspheres of
—PuO_2–UO_2, fabrication of sol-gel-derived
—PuO_2–UO_2, fabrication of fuel rods of
—PuO_2–UO_2, radiation effects on, neutron
PUREX PROCESS—flowsheet development for LMFBR fuels
RADIOCHEMICAL PROCESSING PLANTS—evaluation for reprocessing LMFBR spent fuels
REACTOR FUEL ELEMENTS—shipment of spent LMFBR, criticality and heat dissipation studies for
—reprocessing of stainless steel-clad oxide, shearing studies for
—swelling and gas release in stainless steel-clad oxide
REACTOR FUELS—performance studies on oxide
—reprocessing of LMFBR, research progress (March 1970) on aqueous
—photon spectra of spent LMFBR
—neutron source strength of spent LMFBR

URANIUM OXIDES UO_2—PuO_2–UO_2, dissolution of irradiated, in nitric acid
—preparation from fuel reprocessing solutions, evaluation of processes for
—reactions with carbon and nitrogen
—preparation by sol-gel process
—PuO_2–UO_2, preparation by sol-gel process
—PuO_2–UO_2, preparation of microspheres of
—PuO_2–UO_2, fabrication of sol-gel-derived
—PuO_2–UO_2, fabrication of fuel rods of
—PuO_2–UO_2, radiation effects on, neutron (M.C.G.)

45409 (ORNL-TM-2996) LMFBR FUEL CYCLE STUDIES PROGRESS REPORT FOR APRIL 1970, NO. 14. (Oak Ridge National Lab., Tenn.). May 1970. Contract W-7405-eng-26. 82p. Dep. NTIS.

FISSION PRODUCTS—volatilization from oxide fuels
—solubility in nitric acid
IODINE—separation from fuel reprocessing off-gases
—sorption on zeolites
—chemistry of uncommon volatile species
LIQUID METAL FAST BREEDER REACTOR—fuel cycle development studies (April 1970) on
NEUTRONS—effects on oxide fuels
ORGANIC COMPOUNDS—oxidation in fuel reprocessing off-gas
PLUTONIUM CARBONITRIDES—PuCN–UCN, preparation of
PLUTONIUM OXIDES PuO_2—preparation from fuel reprocessing solutions, evaluation of methods for
—PuO_2–UO_2, dissolution in nitric acid
—PuO_2–UO_2, preparation of sols of
—PuO_2–UO_2, preparation of microspheres from sols of
—PuO_2–UO_2, fabrication of sol-gel-derived
—PuO_2–UO_2, analysis by γ spectroscopy
—PuO_2–UO_2, radiation effects on, neutron
PUREX PROCESS—flowsheet development for LMFBR fuels
REACTOR FUEL ELEMENTS—shipment of spent LMFBR, criticality and heat dissipation studies on
—cladding reaction with oxide fuels in
REACTOR FUELS—reprocessing of LMFBR, research progress (April 1970) on aqueous
—dissolution of spent oxide, in nitric acid
—performance evaluation of oxide
TRANSURANIUM PROCESSING PLANT—iodine evolution and trapping studies at
TRITIUM—volatilization from oxide fuels
URANIUM CARBONITRIDES—PuCN–UCN, preparation of
URANIUM OXIDES UO_2—preparation from fuel reprocessing solutions, evaluation of methods for
—preparation of sols of, CUSP process for
—PuO_2–UO_2, dissolution in nitric acid
—PuO_2–UO_2, preparation of sols of
—PuO_2–UO_2, preparation of microspheres from sols of
—PuO_2–UO_2, fabrication of sol-gel-derived
—PuO_2–UO_2, analysis by γ spectroscopy
—PuO_2–UO_2, radiation effects on, neutron (M.C.G.)

45410 (ORNL-TM-3018) LMFBR FUEL CYCLE STUDIES PROGRESS REPORT FOR MAY 1970, NO. 15. (Oak Ridge National Lab., Tenn.). Jun 1970. Contract W-7405-eng-26. 94p. Dep. NTIS.

FISSION PRODUCTS—volatilization from oxide fuels
IODINE—chemistry in nitric acid solutions in fuel reprocessing
—sorption on zeolites
LIQUID METAL FAST BREEDER REACTOR—fuel cycle development studies (May 1970) on
METHANE, IODO-—sorption on zeolites
ORGANIC COMPOUNDS—oxidation in fuel reprocessing cycle
PLUTONIUM—purification in Purex Process
PLUTONIUM OXIDES PuO_2—PuO_2–UO_2, preparation by sol-gel process
—PuO_2–UO_2, preparation of microspheres of
—PuO_2–UO_2, fabrication of sol-gel-derived
—PuO_2–UO_2, radiation effects on, neutron
RADIOCHEMICAL PROCESSING PLANTS—evaluation for LMFBR spent fuel reprocessing
REACTOR FUEL ELEMENTS—shipment of spent LMFBR, cask evaluation studies for
—reprocessing of, volatile fission product removal in head-end
—cladding reactions with oxide fuel in
—cladding of oxide, economic and performance evaluation of materials for
REACTOR FUELS—reprocessing of LMFBR, research progress (May 1970) on
—radiation properties and shielding of LMFBR
—performance of oxide
URANIUM OXIDES UO_2—preparation by sol-gel process
—PuO_2–UO_2, preparation by sol-gel process
—PuO_2–UO_2, preparation of microspheres of
—PuO_2–UO_2, fabrication of sol-gel-derived
—PuO_2–UO_2, radiation effects on, neutron

45411 (ORNL-TM-3072) LMFBR FUEL CYCLE STUDIES PROGRESS REPORT FOR JUNE 1970, NO. 16. (Oak Ridge National Lab., Tenn.). Jul 1970. Contract W-7405-eng-26. 94p. Dep. NTIS.

FISSION PRODUCTS—volatilization from oxide fuels
—diffusion of gaseous, from oxide fuels
IODINE—volatilization from nitric acid
—separation from fuel reprocess off-gas
—sorption on zeolites
LIQUID METAL FAST BREEDER REACTOR—fuel cycle development studies (June 1970) on
METHANE, IODO-—separation from fuel reprocess off-gas
—sorption on zeolites
NEUTRONS—effects on oxide fuels
NITRIC ACID—reactions with sodium
PLUTONIUM—purification in Purex Process
PLUTONIUM CARBONITRIDES—PuCN–UCN, preparation of
PLUTONIUM OXIDES PuO_2—PuO_2–UO_2, dissolution in nitric acid
—preparation from fuel reprocessing solutions, evaluation of methods for
—PuO_2–UO_2, preparation by sol-gel process
—PuO_2–UO_2, preparation and properties of microspheres of
—PuO_2–UO_2, fabrication of sol-gel-derived, sphere-gas process for
—PuO_2–UO_2, radiation effects on, neutron
RADIOCHEMICAL PROCESSING PLANTS—evaluation for LMFBR fuel reprocessing
REACTOR FUEL ELEMENTS—shipment of spent LMFBR, cask design studies for
—performance studies on stainless steel-clad oxide
—fuel pellet densification in
REACTOR FUELS—reprocessing of LMFBR research progress (June 1970) on
—criticality studies on LMFBR
—fission product release from oxide
SODIUM—reactions with nitric acid
URANIUM CARBONITRIDES—PuCN–UCN, preparation of
URANIUM OXIDES UO_2—PuO_2–UO_2, dissolution in nitric acid
—preparation from fuel reprocessing solutions, evaluation of methods for
—preparation of sols of, CUSP process for
—PuO_2–UO_2, preparation by sol-gel process
—PuO_2–UO_2, preparation and properties of microspheres of
—PuO_2–UO_2, fabrication of sol-gel-derived, sphere-gas process for
—PuO_2–UO_2, radiation effects on, neutron (M.C.G.)

45412 (ORNL-TM-3095) LMFBR FUEL CYCLE STUDIES PROGRESS REPORT FOR JULY 1970, NO. 17. (Oak Ridge National Lab., Tenn.). Aug 1970. Contract W-7405-eng-26. 76p. Dep. NTIS.

FISSION PRODUCTS—volatilization from oxide fuels
—diffusion from oxide fuel
IODINE—release in fuel reprocessing cycle
—spectra of species of, in nitric acid solution
—separation from gas streams by sorption on porous plastics or zeolites
LIQUID METAL FAST BREEDER REACTOR—fuel cycle development studies (July 1970) on
NEUTRONS—effects on oxide fuels
PLUTONIUM—purification in Purex Process
PLUTONIUM OXIDES PuO_2—PuO_2–UO_2, dissolution in nitric acid
—preparation from solutions from fuel reprocessing cycle
—PuO_2–UO_2, preparation of microspheres of
—PuO_2–UO_2, fabrication of sol-gel-derived
—PuO_2–UO_2, radiation effects on, neutron
REACTOR FUEL ELEMENTS—shipment of spent LMFBR, cask evaluation studies for
—thermal conductivity of sheared stainless steel-clad oxide
—reprocessing of, volatilization of fission products in head-end
—mechanical interaction at fuel-cladding interface in
—fission product release in oxide
REACTOR FUELS—reprocessing of LMFBR research progress (July 1970) on
—performance of oxide
URANIUM OXIDES UO_2—PuO_2–UO_2, dissolution in nitric acid

—preparation from solutions from fuel reprocessing cycle
—preparation of sols of, CUSP process for
—preparation of microspheres of
—PuO_2–UO_2, preparation of microspheres of
—PuO_2–UO_2, fabrication of sol-gel-derived
—PuO_2–UO_2, radiation effects on, neutron (M.C.G.)

45413 (ORNL-TM-3127) LMFBR FUEL CYCLE STUDIES PROGRESS REPORT FOR AUGUST 1970, NO. 18. (Oak Ridge National Lab., Tenn.). Sep 1970. Contract W-7405-eng-26. 78p. Dep. NTIS.

FISSION PRODUCTS—reactions in oxide fuels
IODINE—spectra in nitric acid solutions
—volatilization from nitric acid solutions
—separation from gas streams in fuel reprocessing
—distribution between aqueous and gaseous phases
LIQUID METAL FAST BREEDER REACTOR—fuel cycle development studies (August 1970) on
METHANE, IODO-—sorption on zeolites
PLUTONIUM CARBONITRIDES—PuCN–UCN, preparation studies on
PLUTONIUM OXIDES PuO_2—PuO_2–UO_2, dissolution in nitric acid
—preparation from solutions from fuel reprocessing
—PuO_2–UO_2, preparation by sol-gel process
—PuO_2–UO_2, fabrication of sol-gel-derived
—PuO_2–UO_2, radiation effects on sol-gel-derived, neutron
RADIOCHEMICAL PROCESSING PLANTS—evaluation for LMFBR spent fuel reprocessing
REACTOR FUEL ELEMENTS—shipment of spent LMFBR, cask evaluation studies on
—reprocessing of oxide, voloxidation fission product removal in head-end
REACTOR FUELS—reprocessing of LMFBR research progress (August 1970) on aqueous
—performance of oxide
URANIUM CARBONITRIDES—PuCN–UCN, preparation studies on
URANIUM OXIDES UO_2—PuO_2–UO_2, dissolution in nitric acid
—preparation from solutions from fuel reprocessing
—preparation of sols of, CUSP process for
—PuO_2–UO_2, preparation by sol-gel process
—PuO_2–UO_2, fabrication of sol-gel-derived
—PuO_2–UO_2, radiation effects on sol-gel-derived, neutron (M.C.G.)

45414 (ORNL-TM-3180) LMFBR FUEL CYCLE STUDIES PROGRESS REPORT FOR SEPTEMBER 1970, NO. 19. (Oak Ridge National Lab., Tenn.). Oct 1970. Contract W-7405-eng-26. 92p. Dep. NTIS.

DISSOLVERS—forward mixing in continuous
IODINE—properties in nitric acid solutions
—sorption on porous plastic
—chemistry of uncommon volatile species of
KRYPTON—volatilization from oxide fuels
KRYPTON-85—release from irradiated oxide fuels
LIQUID METAL FAST BREEDER REACTOR—fuel cycle development studies (Sept 1970) on
METHANE, IODO-—reactions with nitric acid
—sorption on zeolites
—sorption on porous plastic
NITRIC ACID—reactions with methyl iodide
PLUTONIUM OXIDES PuO_2—preparation from solutions from fuel reprocessing
—PuO_2–UO_2, preparation by sol-gel process
—PuO_2–UO_2, preparation of microspheres
—PuO_2–UO_2, fabrication of sol-gel-derived
—PuO_2–UO_2, radiation effects on sol-gel-derived
RARE EARTH OXIDES—rare earth oxides–UO_2, crystal structure of solid solutions in
REACTOR FUEL ELEMENTS—shipment of spent LMFBR, cask evaluations for
—reprocessing of, fission product removed by voloxidation in head-end
—performance modeling of clad oxide
REACTOR FUELS—reprocessing of LMFBR, research progress (Sept 1970) on aqueous
SOLVENT EXTRACTION PROCESSES—evaluation for LMFBR fuel reprocessing
TRITIUM—distribution in Zircaloy-clad uranium dioxide fuel rods
URANIUM OXIDES UO_2—tritium distribution in Zircaloy-clad fuel rods of
—preparation from solutions from fuel reprocessing
—preparation of sols of, CUSP process for
—PuO_2–UO_2, preparation by sol-gel process
—PuO_2–UO_2, preparation of microspheres of
—PuO_2–UO_2, fabrication of sol-gel-derived
—PuO_2–UO_2, radiation effects on sol-gel-derived
—rare earth oxides–UO_2, crystal structure of solid solutions in (M.C.G.)

45415 (ORNL-TM-3217) LMFBR FUEL CYCLE STUDIES PROGRESS REPORT FOR OCTOBER 1970, NO. 20. (Oak Ridge National Lab., Tenn.). Nov 1970. Contract W-7405-eng-26. 88p. Dep. NTIS.

FISSION PRODUCTS—volatilization from oxide fuels
IODINE—volatilization from nitric acid
—spectra in nitric acid solutions
—partition between aqueous and gaseous systems
—chemistry of uncommon volatile species of
KRYPTON—volatilization from oxide fuels
LIQUID METAL FAST BREEDER REACTOR—fuel cycle development studies (Oct 1970) on
METHANE, IODO-—sorption from gas streams on solids
—reactions with nitric acid
PLUTONIUM CARBONITRIDES—PuCN–UCN, preparation of
PLUTONIUM OXIDES PuO_2—PuO_2–UO_2, dissolution in nitric acid
—preparation from solutions from fuel reprocessing
—PuO_2–UO_2, preparation of microspheres of
—PuO_2–UO_2, fabrication of sol-gel-derived
—PuO_2–UO_2, radiation effects on sol-gel-derived
REACTOR FUEL ELEMENTS—cladding mechanical interactions with oxide fuel in, FMØDEL code prediction of
—shipment of spent LMFBR, heat dissipation and shielding studies for
REACTOR FUELS—reprocessing of LMFBR, research progress (Oct 1970) on aqueous
—performance evaluation of oxide
SOLVENT EXTRACTION PROCESSES—evaluation for reprocessing LMFBR fuels
URANIUM CARBONITRIDES—PuCN–UCN, preparation of
URANIUM OXIDES UO_2—PuO_2–UO_2, dissolution in nitric acid
—preparation from solutions from fuel reprocessing
—preparation of sols of, CUSP process for
—PuO_2–UO_2, preparation of microspheres of
—PuO_2–UO_2, fabrication of sol-gel-derived
—PuO_2–UO_2, radiation effects on sol-gel-derived (M.C.G.)

45416 (ORNL-TM-3250) LMFBR FUEL CYCLE STUDIES PROGRESS REPORT FOR NOVEMBER 1970, NO. 21. (Oak Ridge National Lab., Tenn.). Jan 1971. Contract W-7405-eng-26. 93p. Dep. NTIS.

AIR—separation of fission product iodine and tritium from
FISSION PRODUCTS—volatilization from oxide fuels
IODINE—volatilization from nitric acid solutions
—spectra in nitric acid solutions
—separation from air by cold trapping
—chemistry of uncommon volatile species of
LIQUID METAL FAST BREEDER REACTOR—fuel cycle development studies (Nov 1970) on
METHANE, IODO-—separation from air by cold trapping
—sorption on solids, research progress on
PLUTONIUM—purification in Purex Process
PLUTONIUM OXIDES PuO_2—PuO_2–UO_2, oxidation of unirradiated pellets of
—PuO_2–UO_2, dissolution in nitric acid
—preparation from solutions from fuel reprocessing
—PuO_2–UO_2, preparation by sol-gel process
—PuO_2–UO_2, preparation of microspheres
—PuO_2–UO_2, fabrication of sol-gel-derived
—PuO_2–UO_2, analysis of pellets of, for moisture
—PuO_2–UO_2, radiation effects on sol-gel-derived
REACTOR FUEL ELEMENTS—shipment of spent LMFBR, heat dissipation studies for
—reprocessing of clad oxide, head-end steps in
—criticality studies on spent LMFBR
—cladding mechanical interaction with fuel in
—performance evaluation of clad oxide
REACTOR FUELS—reprocessing of LMFBR, research progress (Nov 1970) on aqueous
SODIUM—reactions of, survey on
TRITIUM—release in reprocessing of oxide fuels
—separation from air by cold trapping
URANIUM CARBONITRIDES—preparation of
URANIUM OXIDES UO_2—preparation from solutions from fuel reprocessing
—preparation of sols of, CUSP process for
—PuO_2–UO_2, preparation by sol-gel process
—PuO_2–UO_2, preparation of microspheres
—PuO_2–UO_2, fabrication of sol-gel-derived

—PuO_2–UO_2, analysis of pellets of, for moisture
—PuO_2–UO_2, radiation effects on sol-gel-derived
—PuO_2–UO_2, oxidation of unirradiated pellets of
—PuO_2–UO_2, dissolution in nitric acid (M.C.G.)

45417 (ORNL-TM-3281) LMFBR FUEL CYCLE STUDIES PROGRESS REPORT FOR DECEMBER 1970, NO. 22. (Oak Ridge National Lab., Tenn.). Jan 1971. Contract W-7405-eng-26. 85p. Dep. NTIS.

CARBON—reactions with nitrogen and uranium dioxide
FISSION PRODUCTS—diffusion in oxide fuels
IODINE—volatilization from nitric acid solutions
—separation from fuel reprocessing off-gases
—separation from aqueous solutions
—spectra in alkaline and nitrate solutions
LIQUID METAL FAST BREEDER REACTOR—fuel cycle development studies (Dec 1970) on
METHANE, IODO-—reactions with nitric acid
NITROGEN—reactions with carbon and uranium dioxide
PLUTONIUM OXIDES PuO_2—PuO_2–UO_2, solubility in nitric acid
—preparation from solutions from fuel reprocessing
—PuO_2–UO_2, preparation by sol-gel process
—PuO_2–UO_2, preparation of microspheres of
—PuO_2–UO_2, fabrication of sol-gel-derived
—PuO_2–UO_2, radiation effects on sol-gel-derived
—PuO_2–UO_2, diffusion of fission products in
REACTOR FUEL ELEMENTS—performance of clad oxide
—shipment of spent LMFBR, cask evaluation for
REACTOR FUELS—reprocessing of LMFBR, research progress (Dec 1970) on
—radiation effects on restructuring of ceramic, model for
SODIUM—reactions of, review on
STAINLESS STEEL—creep of tubing of
URANIUM OXIDES UO_2—PuO_2–UO_2, solubility in nitric acid
—preparation from solutions from fuel reprocessing
—reactions with carbon and nitrogen
—preparation of sols of, CUSP process for
—PuO_2–UO_2, preparation by sol-gel process
—PuO_2–UO_2, preparation of microspheres of
—PuO_2–UO_2, fabrication of sol-gel-derived
—PuO_2–UO_2, radiation effects on sol-gel-derived
—PuO_2–UO_2, diffusion of fission products in (M.C.G.)

45418 PROCESSING OF SOLIDS ON FLUIDIZED BEDS. Bergougnou, M. A. (Univ. of Western Ontario, London). Chim. Ind., Genie Chem.; 105: No. 9, 559-71(Apr 1972). (In French).

Fluidization has extensive applications in the processing of solids: coal distillation, coal combustion, incineration of organic residues, elimination of radioactive residuary slurries, ore reduction (iron ore in particular), ore enrichment, and high temperature electrothermal processes. The agricultural, medical and nuclear applications (fuel processing and reprocessing, coating of nuclear fuel particles with pyrolitic carbon) are described. General considerations on the calculation of fluidized units for the processing of solids are given. (France)

45419 NEW METHOD OF NUCLEAR FUEL REPROCESSING. Perrot, Michel (Ugine-Kuhlmann, Paris). Ind. At. Spatiales; 26: No. 1, 15-24(Jan 1972). (In French and English).

The reprocessing of irradiated fuels by the volatilization of fluorides is reviewed after a brief description of the different types of fuel and possibilities in Europe. The advantages of this technique are described on the basis of experimental results and comparative economic studies. (France)

45420 PROCESSING OF IRRADIATED NUCLEAR FUELS. Mills, Alfred Leonard; Vivers, Robert William Jackson (to United Kingdom Atomic Energy Authority). U. S. Patent 3,672,848. 27 Jun 1972. Filed 31 Dec 1969.

Irradiated monocarbide nuclear fuel is dissolved in nitric acid and the solution is subjected to the oxidizing effect of ozone or electrolytic oxidation to effect oxidation of organic compounds in the solution. Oxidation is terminated at the onset of the conversion of plutonium in the solution to the hexavalent state. (Official Gazette)

45421 CONTAINMENT OF FISSION PRODUCT IODINE IN THE REPROCESSING OF LMFBR FUELS BY PYROCHEMICAL REACTIONS. Krumpelt, M.; Heiberger, J. J.; Maroni, V. A.; Steindler, M. J. (Argonne National Lab., Ill.). Nucl. Technol.; 15: No. 3, 391-5(Sep 1972).

The reaction of elemental iodine with liquid zinc and the reaction of ZnI_2 with molten chloride salt were studied. These reactions, which occur when fission product iodine is released into a zinc-salt melt during the pyrochemical decladding of fuel elements, appear to be very rapid. The mechanism is postulated to include conversion of zinc iodide to a zinc chloride complex. The presence of zinc chloride in the melt was verified by Raman spectroscopy. The results of laboratory-scale experiments suggest that the process for decladding LMFBR fuels in a zinc-salt melt may be capable of effectively retaining fission-product iodine in an easily disposable form. (auth)

45422 METHOD OF EXTRACTING FUEL FROM NUCLEAR FUEL ELEMENTS. Ballet, Paul; Faugeras, Pierre; Lefort, Guy (to Commissariat a l'Energie Atomique). French Patent 2,081,176. 3 Dec 1971. Filed 13 Mar 1970. (In French).

A method of extracting the fuel core from a nuclear fuel element with a metallic cladding is described. An electrochemical method is used to cut the cladding. HNO_3 is introduced under pressure into the cladding in order to leach the fuel. The fuel material is dissolved in the electrolyte (HNO_3) arising from the leaching by concentration in a dissolver-evaporator; the distilled electrolyte is then recycled in the evaporator. The extraction is effected by nitric acid leaching of the UO_2–PuO_2 fuel from the stainless steel–clad fast neutron reactor elements. (France)

45423 EXTRACTION OF FISSION PRODUCT NOBLE METALS FROM SPENT NUCLEAR FUELS. MacCragh, Adolfo (to W. R. Grace and Co.). U. S. Patent 3,672,875. 27 Jun 1972. Filed 5 Sep 1969.

A process for separating fission product metals from spent nuclear fuels, in which the insolubles from fuel element dissolution are heated in a stream of halide gas to convert the residues to the halides, is described. Ruthenium and rhodium fractions are converted to the complex haloruthenite and halorhodite, followed by dissolution and distillation to remove ruthenium. The rhodium is recovered by neutralizing the undistilled portion and reducing to the metal. Palladium and technetium are recovered from the halides volatilized in the first step of the process. (Official Gazette)

ENGINEERING

Energy Conversion

Refer also to abstracts: 45432, 45487, 45704, and 47170.

45424 (N-72-15607) CONCEPTUAL DESIGN STUDY OF A NUCLEAR BRAYTON TURBOALTERNATOR-COMPRESSOR. (General Electric Co., Cincinnati, Ohio). Nov 1971. Contract NAS3-13449. 526p. (NASA-CR-113925; GESP-493). NTIS.

A comprehensive analysis and conceptual design study of the turboalternator-compressor components using He-Xe as the working fluid was performed. The study was conducted in three phases: general configuration analysis (Phase 1), design variations (Phase 2), and conceptual design study (Phase 3). During the Phase 1 analysis, individual turbine, alternator, compressor, and bearing and seal designs were evaluated. Six turboalternator-compressor (TAC) configurations were completed. Phase 2 consisted of evaluating one selected Phase 1 TAC configuration to calculate its performance when operating under new cycle conditions, namely, one higher and one lower turbine inlet temperature and one case with krypton as the working fluid. Based on the Phase 1 and 2 results, a TAC configuration that incorporated a radial compressor, a radial turbine, a Lundell alternator, and gas bearings was selected. During Phase 3 a new layout of the TAC was prepared that reflects the cycle state points necessary to accommodate a zirconium hydride moderated reactor and a 400 Hz alternator. The final TAC design rotates at 24,000 rpm and produces 160 kW(e), 480 V, 3-phase, 400 hertz power. (auth) (STAR)

45425 (N-72-16724) EFFECT OF TWO TYPES OF HELIUM CIRCULATORS ON THE PERFORMANCE OF A SUBSONIC NUCLEAR-POWERED AIRPLANE. Strack, William C. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Mar 1971. 29p. (NASA-TM-X-2237; E-5811). NTIS.

Two types of helium circulators are analytically compared on the bases of their influence on airplane payload and on propulsion system variables. One type of circulator is driven by the turbofan engines with power takeoff shafting while the other, a turbocirculator, is powered by a turbine placed in the helium loop between the nuclear reactor and the helium-to-air heat exchangers inside the engines. Typical results show that the turbocirculator yields more payload for circulator efficiencies greater than 0.82. Optimum engine and heat exchanger temperatures and pressures are significantly lower in the turbocirculator case compared with the engine-driven circulator scheme. (auth) (STAR)

45426 COMPOSITE WALLS FOR MAGNETOHYDRODYNAMIC APPARATUS. Blattmann, Henri; Javellaud, Jean; Yerouchalmi, David (to Commissariat a l'Energie Atomique). French Patent 2,082,735. 15 Nov 1971. Filed 25 Mar 1970. (In French).

Improvements to the composite walls of MHD apparatus are presented. They are applicable to both the electrodes and the insulating walls. The composite wall of a MHD generator is constructed from an assembly of principal elements, each element being composed of several types of subelement. The principal elements are assembled using trapezoidal prismatic spacers made of insulating refractory ceramic material contained between two sheets of corrugated steel. The spacers are made of magnesia or strontium zirconate. The principal elements of these walls can be divided into several different parts by transversely positioned corrugated steel sheets. (France)

45427 THERMAL CONTROL AND POWER FLATTENING FOR RADIOISOTOPIC THERMODYNAMIC POWER SYSTEM. Bienert, Walter B.; Levedahl, William J.; Streb, Alan J. (to Teledyne, Inc.). U. S. Patent 3,672,443. 27 Jun 1972. Filed 28 Jan 1969.

A thermal control device utilizing the heat pipe principle is described. Heat receiving and heat rejecting surfaces are spaced from each other along the length of the heat pipe. In a preferred form, a radioisotope fuel capsule is in thermal conducting relationship with the heat receiving surface and a noncondensible gas is mixed with the working fluid of the heat pipe. A noncondensible gas automatically expands as the threshold temperature of the system drops to block off more of the heat rejecting surface. In other alternate preferred embodiments, a nonvaporizable liquid is utilized in lieu of a noncondensible gas to reduce the area of the heat receiving surface as the threshold temperature of the system drops or a second material is mixed with the working fluid which changes to a solid phase to block the flow of the working fluid between the heat rejecting and heat receiving surfaces as the threshold temperature of the system drops. (Official Gazette)

45428 LASER POWER STATIONS IN ORBIT. Hansen, C. Frederick; Lee, George (Ames Research Center, Moffett Field, Calif.). Astronaut. Aeronaut.; 10: No. 7, 42-55(Jul 1972).

Application of nuclear-fueled laser satellites to beam power to lunar bases and other spacecraft are proposed. Cycles for converting laser radiation to electric energy are considered along with electrostatic ion propulsion. It is noted that such vehicles would carry only power conversion systems, appropriate thrusters, and fuels. (J.R.D.)

45429 NEW CONCEPT IN ENERGY TRANSMISSION. Gregory, Derek P. (Inst. of Gas Tech., Chicago). Pub. Util. Fortn.; 89: No. 3, 21-9(3 Feb 1972).

As the U. S. moves from a fossil fuel economy toward a nuclear power age to meet burgeoning energy demands, the problems of electricity transmission, distribution, and storage become accentuated. An alternative exists to the growing number of overhead power lines appearing around cities. Hydrogen is a synthetic fuel that could be made from water and electricity at the power stations and used as a means of underground energy transmission. It is an ideal fuel in many respects for combustion to obtain heat or for reconversion to electricity near the user. Economically, transmission of a gas is far cheaper than transmission of electric power, especially underground. This concept is not without its problems; nevertheless, it surely deserves detailed consideration in the future. (auth)

45430 INVESTIGATION OF OPTIMUM CONDITIONS FOR ENERGY CONVERSION IN MHD GENERATOR. Zaporowski, B. (Technical Univ., Poznan, Poland). Pr. Inst. Masz. Przeply.; No. 54-55, 77-84(1971). (In Russian).

Investigation of the efficiency of heat conversion into electric energy in the MHD generator as a function of initial energy parameters of the plasma is described. There are given values of energy parameters and physical properties of the plasma obtained by combustion of conventional fuels in the oxidizer of variable O_2-content, and its variable physical enthalpy, account taken of the losses of energy for cooling the combustion chamber and duct as well as for introducing the ionizing seed and the like. An analysis of the influence of energy parameters of the plasma on the output obtained from the unit volume of the duct, varying along its axis is presented. A short description of a MHD generator having a thermal power of 4 MW, is included. (NSA of Poland)

45431 ELECTRICAL PARAMETERS IN THE HALL-TYPE MAGNETOHYDRODYNAMIC GENERATOR WITH GAS PROPERTY NONUNIFORMITIES IN THE DIRECTION OF THE MAGNETIC FIELD. Celinski, Z. N. (Inst. of Nuclear Research, Warsaw). Rozpr. Elektrotech.; 17: 109-23(1971).

The effects of gas velocity and temperature distributions in the direction of a magnetic field on the electrical parameters of the Hall-type MHD generator were considered. The nonuniform distribution of gas velocity leads to the formation of circulating currents in the x and y directions. The Ohmic losses increase slightly. The terminal values of the generator do not change sufficiently in comparison to the constant gas property generator. The internal resistance is practically unchanged; the terminal voltage and the generated power increase slightly. The expressions for the electrical values were derived and a numerical example was calculated. (NSA of Poland)

45432 RADIATSIONNAYA TEKHNIKA. VYPUSK 6. (Radiation Technology. Number 6). Shtan, A. S. (ed.). Moscow; Atomizdat (1971). 256p.

This collection of 43 articles by various authors presents theoretical and experimental work on isotope thermoelectric generators, irradiation equipment, pulsed proton generators, nuclear methods of analysis, and gamma defectoscopy. A few papers deal with radiotherapy and x-ray diagnostic apparatus. The production of isotopes using neutrons, neutron activation and neutron resonance analysis is discussed. (K.S.W.)

45433 CONVERSION OF HIGH-TEMPERATURE PLASMA ENERGY INTO ELECTRICAL ENERGY. Post, Richard F. (to United States Atomic Energy Commission). U. S. Patent 3,663,360. 16 May 1972. Filed 13 Aug 1970.

High temperature plasma is produced in a containment zone of a controlled fusion reactor defined by a magnetic containment field from which field plasma emerges as a beam. The plasma beam is directed through the magnetic field of an expander which

expander field is coupled to the containment field and diminishes in intensity therethrough so that rotational energy of the plasma ions is converted to translational kinetic energy. An arrangement is provided at the outlet of the expander to separate electrons from the high energy ions which ions are then directed into a collector structure. The collector structure comprises a plurality of stages maintained at progressively higher positive potentials wherein the ions are progressively decelerated so that successive fractions of the ions passes residual kinetic energies less than the differential potential between successive collector stages. The collector stages are provided with a deflector means which selectively deflects the ions with low residual kinetic energies to impinge upon collector plates to create electrical current at the stage potential. In one disclosed embodiment, the selective deflector means utilizes a vapor jet charge exchange arrangement, in a second, the selective deflector means is an arrangement using crossed electric and magnetic fields, and, in a third, the selective deflector means utilizes particle focusing lenses. Electrical circuitry means are provided for combining and/or converting the individual collector currents for delivery to an electrical distribution system with means to establish the initial decelerating or retarding potentials. (auth)

45434 ELECTROCHEMICAL POWER-PRODUCING CELL. Cairns, Elton J.; Chilenskas, Albert A.; Steunenberg, Robert K.; Shimotake, Hiroshi (to United States Atomic Energy Commission). U. S. Patent 3,666,560. 30 May 1972. Filed 21 Sep 1970.

An electrochemical power-producing cell is described including a molten lithium metal anode, a molten selenium metal cathode, a paste electrolyte separating the anode from the cathode, an anode current collector, and a single layer of niobium expanded metal formed in corrugated shape as cathode current collector. In addition, means are provided for sealing the anode and the cathode from loss of lithium and selenium respectively. An insulator is provided between the anode housing and the paste electrolyte disk. (Official Gazette)

Facilities and Equipment

Refer also to abstract: 47300.

45435 (CEA-CONF-2008) HEAT PIPES. DESIGN AND INDUSTRIAL APPLICATIONS. Semeria, R. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 1971. 16p. (In French). (CONF-710651-3). Dep. NTIS (U. S. Sales Only).

From International conference on heat exchangers; Paris, France (16 Jun 1971).

Heat pipes are thermosiphons with vaporization where we can distinguish a boiler, a condenser, and eventually an adiabatic zone. To insure the returning liquid flow from the condenser to the boiler, surface tension forces, associated with the gravity forces, if need be, are used. For this, the condensing liquid is sucked by a capillary structure, generally situated against the inner wall. The review of the design methods, and particularly the prediction of the maximal performances shows the advantages and limitations of such devices. The main difficulties are technological for the heat pipes with high temperature liquid metals. The thermohydrodynamic limitations are: the maximum power (which can be calculated by a balance between friction forces and active forces), the maximum heat flux leading to the dry-out of the evaporator, and the critical conditions for the start up associated with the sonic conditions in the vapor phase. Heat pipes designed for industrial applications (mainly for space) are described. (auth)

45436 (CEA-CONF-2010) DESIGN CONSIDERATIONS OF HEAT EXCHANGERS FOR VAPORIZING FLUIDS. Fabrega, S.; Huyghe, J.; Ricque, R. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 1971. 13p. (In French). (CONF-710651-2). Dep. NTIS (U. S. Sales Only).

From International conference on heat exchangers; Paris, France (16 Jun 1971).

Aspects of determining the steady-state operating characteristics of certain types of vapor generating equipment are examined. A type of equipment considered is the vertical tube reboiler with upward flow. A calculation method applicable to industrial mixtures is described, wherein the evolution of mixture composition along the tube is accounted for. Based on results obtained with an experimental unit of this type, an attempt was made to develop correlations for the pressure drop and the heat transfer rate that would apply at relatively low pressures (a few bars). Also discussed are falling film, long tube vertical evaporators, and a boiling system often found in industrial situations. Methods and results are presented that permit predictions of the heat transfer coefficient and the pressure drop. For the case of horizontal, once-through vapor generators at high pressures, the influence of gravity leads to non-symmetrical flow and heat transfer patterns inside the tubes. First results with Freon are presented to permit an analysis of this asymmetry, and in addition, to permit examination of the effect of elbows. Aspects of boiling outside horizontal or vertical tubes are considered in connection with the operation of low-pressure boilers often encountered in seawater desalting units (subatmospheric pressures) and in the chemical industry. (auth)

45437 (CONF-720904-1) DESIGN OF HIGH-TEMPERATURE LIQUID METAL SYSTEMS. Fraas, A. P. (Oak Ridge National Lab., Tenn.). 13 Sep 1972. 27p. Dep. NTIS.

From Conference on the impact of aerospace technology on society in the 70's; Los Angeles, CA. (11 Sep 1972).

A review of over two million hours of high-temperature liquid metal system operating experience gained under the Aircraft Nuclear Propulsion and Nuclear Electric Space Power Plant programs at ORNL during the past 22 years may prove helpful to those who have occasion to design high-temperature liquid metal systems for other applications. The nature of the problems involved in material selection, mass transfer and corrosion, heat transfer and heat transport, limitations imposed by oxidation of external surfaces of a system, the performance characteristics of various liquid metals relative to other heat transfer media such as high-pressure helium and various molten salts, thermal stress and thermal strain cycling, and problems posed by the fire hazard potential all play obviously important roles in the design of high-temperature liquid metal systems. In addition, experience has shown that liquid metal systems are singularly unforgiving of small errors in design, shakedown, and operation. This in turn means that much attention must be devoted to the detail design of components to provide a high degree of leak tightness, reasonable freedom from thermal strain cycling, and a host of special problems such as self welding. A set of design precepts for liquid metal systems is presented along with selected references as an aid to those interested in this field. (auth)

45438 (KFK-1556) CONCEPT OF AN IRRADIATION FACILITY FOR INVESTIGATION OF HIGH-TEMPERATURE THERMOELEMENTS AT TEMPERATURES TO 2000°C. Piel, D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). Mar 1972. 29p. (In German). Dep. NTIS (U. S. Sales Only).

In addition to general indications with respect to W/Re thermocouples and the aims pursued in a high-temperature irradiation program an irradiation rig is described. This rig may be used to investigate the behavior of high-temperature thermocouples in the radiation field of a reactor, using a gas thermometer. The most important instability effects of thermocouples are discussed and given as experimental parameters. The irradiation capsule has been designed for insertion into the Br2 Reactor at Mol and for temperatures of about 2000°C. The individual heat transport mechanisms are described which underly the calculation of temperature distribution. (auth)

45439 (KFK-1566) RECUPERATIVE HEAT EXCHANGER FOR A FAST HELIUM-COOLED BREEDER REACTOR WITH HELIUM TURBINE. Savatteri, C. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Feb 1972. 32p. (In German). (EUR-4725). Dep. NTIS (U. S. Sales Only).

In a plant operated by a gas-cooled fast breeder reactor and a gas turbine the amount of heat transferred in the recuperative heat exchanger is almost identical to that in the reactor. Since the inlet temperatures of the turbine and the condenser are also fixed in advance, the efficiency of the process is decisively dependent on the heat exchanger. In order to obtain guide lines for the final design of the recuperator of a 1000 MWe plant, preliminary calculations of variations are carried out. This work investigates the influence of various parameters (tube diameter, pitch ratio, loss of pressure distribution) on the size of the heat exchanger. For better understanding of the problems the plant is briefly described. (auth)

45440 (MSAR-71-45) ENTRAINMENT MOISTURE SEPARATORS FOR FINE (1–10 μ) WATER–AIR–STEAM SERVICE: THEIR PERFORMANCE, DEVELOPMENT, AND STATUS. Final Report. Griwatz, Gunther H.; Friel, Joseph V.; Bicehouse, Jack L. (MSA Research Corp., Evans City, Pa.). Mar 1971. Contract AT(45-1)-2145. 163p. Dep. NTIS.

There is a need for moisture separators that are at least 99% efficient in removing entrained water particles in the 1 to 10 micron (μ) range from air streams. Five commercially available entrained moisture separators were tested for performance in the 1 to 10 micron particle-size range. The MSA Type G and the AAF Type T separators were greater than 99% efficient in removing particles in this range from atmospheric to PWR post-accident

(incident) conditions. The York Type 321 SR separator failed to contain the separated water within the drains of the unit and re-entrainment occurred. The Farr Type 68-44ZH and the Monsanto baffle-type separators were inferior because of visible and measured penetration. MSA test details and results are summarized. Survey results, presenting the status of entrainment separators and media for 1 to 10 micron service, together with methods of measuring and generating particles in this range, have been previously reported. (auth)

45441 (SRARI-P-120) REALIZATION OF SYNCHRONOUS ROTATION OF SOME ROTORS SUSPENDED IN A MAGNETIC FIELD. Rukolaine, G. V.; Kalebin, S. M.; Pelevin, G. A.; Nikol'skii, S. N. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1971. 24p. (In Russian). Dep. NTIS (U. S. Sales Only).

A method for the synchronous rotation of any number of rotors suspended in a magnetic field is considered. The advantage is taken of such distinctive features of suspension in a magnetic field as low friction during rotation of the rotors, and the absence of mechanical effects on the angular rate of rotation. The operational principle of electronic tracing circuits made for specified synchronization is described. The following technical characteristics are available in the arrangement developed: the rotation period of the rotors suspended in a magnetic field varies no more than 0.25 μs, and their synchronous rotation measured at the rate of 6000 rpm is performed accurately to ±0.04°. (auth)

45442 DETERMINATION OF THE PERFORMANCE OF STEAM SEPARATORS WITH THE AID OF THE LAWS OF SIMILITUDE. Brandes, H. (Technische Univ., Hanover). Kerntechnik; 14: No. 5, 210-19(May 1972) (In German and English).

In modern high-performance steam generators, especially those of nuclear design, a sufficient separation of the generated steam/water mixture cannot be obtained by gravitational means alone. Therefore, not only steam dryers but also so-called steam separators, usually of the centrifugal type, are installed to ensure a low steam content (carryunder) in the water returning to the heating section of the steam generator. A low carryunder is necessary to stabilize the flow and to ensure a good heat transfer in the heating section. An investigation of separators of a centrifugal type was performed to obtain empirical relations for the calculation of pressure drop and carryunder in future designs of similar separators. The laws of similitude were applied to analyze the test data. It is shown that, by a dimensional analysis, the pressure drop of the tested separator type can be satisfactorily predetermined whereas calculations of carryunder will yield only approximate results. (auth)

45443 DYNAMIC RESPONSE OF A PLATE TO TIME-DEPENDENT BOUNDARY CONDITIONS. Ramachandran, J. (Indian Inst. of Tech., Madras). Nucl. Eng. Des.; 21: No. 3, 339-49 (1972).

The dynamic response of a simply supported rectangular plate to time-dependent boundary conditions is considered. Results are presented for the cases when (1) any one of the boundaries and (2) any two opposite boundaries are subject to a certain prescribed time-dependent displacement. The analysis is extended to a case where the plate carries a concentrated mass situated at some point within the domain. Numerical examples are given for all the cases considered. (auth)

45444 DISTRIBUTION OF A RADIOACTIVE AEROSOL IN A MODEL CHAMBER. Zalmanzon, Yu. E.; Nikitin, V. I.; Chutkin, O. A. (Scientific Research Inst. for Equipment Construction, Moscow). Gig. Sanit.; No. 3, 47-51(Mar 1972). (In Russian).

A chamber is described which can be filled with a radioactive aerosol which is generated by bubbling pure air through a solution of a salt of a radioisotope. Working with NH_4Br-labeled the beta-emitter ^{82}Br, the aerosol generated had an average activity of 2×10^{-12} to 5×10^{-14} Ci/liter. Samples were taken from the corners and other parts of the chamber in order to determine the effectiveness of mixing. The isotope concentration showed a vertical variation of from 20 to 90%. (K.S.W.)

45445 STRESS DISTRIBUTION IN NOZZLE-TO-CYLINDER CONNECTIONS FOR SMALL DIAMETER RATIOS. Van Campen, D. H.; Spaas, H. A. C. M. (Delft Univ. of Tech., Netherlands). Nucl. Eng. Des.; 21: No. 3, 368-95(1972).

Development of a finite element computational method is described, which is intended for determining the detailed distribution of strain and stress (inclusive the peak stresses) in nozzle-to-cylinder intersections for sufficiently small d/D ratios (typically $d/D \leq 1/4$). The proposed method can be considered as an extension of the computational method for the biaxially loaded nozzle-to-flat plate connection presented previously, which is based upon the finite element method for solids of revolution under non-axisymmetric loadings. The two computational methods (nozzle-to-flat plate and nozzle-to-cylindrical vessel) are compared with each other and the reliability of both is evaluated by comparison with experimental evidence. (auth)

45446 POOL IRRADIATOR WITH RADIATION SOURCE IN A ROTATING CONTAINER. Ransohoff, Jackson A. (to Neutron Products Inc.). U. S. Patent 3,665,183. 23 May 1972. Filed 28 May 1969.

An irradiator operable with a radiation source under the surface of a pool of water includes a gas filled space within the irradiator and between the irradiation source and various positions in which containers of material are irradiated. The various positions are at preselected distances from the source to allow simultaneous experiments and the gas filled space conserves radiation. The radiation source may be a plurality of rods within tubes arranged circumferentially to one of the containers of material to be irradiated and the containers of material to be irradiated may be rotated during irradiation. (Official Gazette)

45447 PRODUCTION IRRADIATOR. Ransohoff, Jackson A.; Sarkozi, Lewis P. (to Neutron Products, Inc.). U. S. Patent 3,676,675. 11 Jul 1972. Filed 29 May 1969.

Irradiation of material in packages is carried out continuously by a unique conveyor arrangement which transports closely spaced carriers containing the packages in vertical runs past a radiation source. The radiation conveyor utilizes extension arms to increase the radius of outside turns and allow the carriers to be spaced closer to the source and to each other. A transfer conveyor is provided to obviate the need for inside turns so that individual carriers and adjacent vertical runs may be closely spaced in the radiation zone. A loading station provides means for the horizontal loading and unloading of the packages in increments to provide for the integration of the radiation dose horizontally across the carrier length. An effective labyrinth radiation shield above the source shields the loading station. The radiation dosage per pass through the system may be varied by varying the speed of the conveyor or the strength of the radiation source plaque. (Official Gazette)

45448 APPARATUS FOR IRRADIATION IN A CONTROLLED ATMOSPHERE. Coleman, Goerge E. (to PPG Industries, Inc.). U. S. Patent 3,676,673. 11 Jul 1972. Filed 18 Aug 1969.

Apparatus which permits treatment of products with ionizing radiation in a controlled atmosphere comprises an inner chamber positioned within an outer chamber. The workpiece to be treated passes through the inner chamber. The outer chamber has a radiation-permeable window in one surface and the second chamber has means for the passage of radiation in juxtaposition with the window in the outer chamber. The apparatus may also contain means for carrying the product to be treated, as well as cooling means at the end of the radiation path. (Official Gazette)

45449 METHOD OF FABRICATING A HEAT PIPE. Werner, Richard W.; Alexander, Everette E.; Comstock, Irving J. (to United States Atomic Energy Commission). U. S. Patent 3,665,573. 30 May 1972. Filed 18 May 1970.

A tube is provided having a plurality of closely spaced very thin longitudinal fins projecting into its interior. The tube is particularly useful as a heat pipe, the capillaries defined between adjacent fins serving as a wicking structure for conveying a heat transfer working fluid from one region of the pipe to another by capillary pumping. Fabrication of the internally finned tube is accomplished by a sacrificial mandrel method. (Official Gazette)

45450 SODIUM HEATED STEAM GENERATOR. Creek, Ronald B.; Gardner, Karl A. (to United States Atomic Energy Commission). U. S. Patent 3,662,718. 16 May 1972. Filed 2 Mar 1971.

A sodium-heated steam generator is described having a tube sheet which is subject only to saturated or near saturated steam temperatures. Double-walled evaporative and superheated steam tubes extend through said tube sheet into the liquid metal. In both the evaporative and superheated steam tubes the saturated steam passes through the annular passageways which contact the tube sheet. (Official Gazette)

45451 MIXER-SETTLER APPARATUS. Miller, William E.; Knighton, James B.; Bernstein, George J. (to United States Atomic Energy Commission). U. S. Patent 3,663,178. 16 May 1972. Filed 3 Jun 1969.

An apparatus is described for simultaneously mixing and separating multiple phase fluids in which one phase is retained as a batch phase and the other phases are continuously flowing. A pump-mixer continuously mixes the fluids and pumps them into a settling chamber where they settle out and means are provided in the settling chamber for returning one phase to the mixer from which it came and transferring the other phases to another pump-mixer. Apparatus is provided for retaining as a batch or captive phase either heavy or light phases. (Official Gazette)

45452 DENITRATOR 5 IN (29 Nov 1971) (Engineering Materials). (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). (CAPE-724).

7 drawings.

This denitrator is a scaled-down and modified version of a denitrator developed at Hanford. It is used to convert uranyl nitrate ($UO_2(NO_3)_2$) to uranium trioxide (UO_3). (For details see TID-4100 Suppl. 72) (F.S.)

45453 CONSISTENT THEORY FOR SPHERICAL SHELLS IN EQUILIBRIUM. Palusamy, S. (Sir George Williams Univ., Montreal); Lind, N. C. Nucl. Eng. Des.; 21: No. 3, 350-7 (1972).

A consist nt theory in the sense that the displacement and stress fields not only satisfy respectively the kinematic and static requirements, but also the requirements of the principle of virtual work, is presented for a thin spherical shell in equilibrium; the results are useful in plastic limit analysis where this consistency is a prerequisite for the application of the theorems of limit analysis. (auth)

45454 DEVELOPMENT OF 50Hz 44 INCH TURBINE BLADE. Okubo, Atsuo (Takasago Machinery Works, Japan); Kadoya, Yoshiki; Sato, Tomohiko; Umemura, Sunao; Kuramoto, Yasuo. Tech. Rev., Mitsubishi Heavy Ind.; 9: No. 1, 21-30(Feb 1972).

A 50-Hz, 44-inch low pressure end turbine blade was developed to build 1,000-MW class fossil- and nuclear-fueled power plants for reliability and high efficiency. Optical and traverse tests in high-speed cascade wind tunnel were carried out to determine the cascade performance of the blade, resulting in very low cascade losses. Rotating vibration tests using actual blades and disk revealed the blade had excellent vibratory characteristics. The design features and results of high-speed cascade test and rotating vibration test for the blade are described. (auth)

45455 MANUFACTURING DETAILS AND MATERIAL USED FOR MANUFACTURE OF THROTTLE, CONTROL, INTERCEPTOR, AND STOP VALVES FOR HIGH RATING STEAM TURBINES OF CONVENTIONAL AND NUCLEAR TYPE. Celaschi, Emilio (Franco Tosi SpA, Legnano, Italy). Termotecnica (Milan); 26: No. 5, 243-8(May 1972). (In Italian).

The evolution of throttle, control, interceptor, and stop valves for 160, 320, and 600 MW conventional turbogenerator units is described. Descriptions of nuclear stations with outputs at 300 to 1200 MW are also included. Improved turbogenerator reliability is noted as a result of recent developments. (J.R.D.)

45456 IRRADIATOR APPARATUS WITH A FLUID FLOW-PATH DETERMINED BY COMMUNICATING CORE AND CASTING BAFFLES. Woodbridge, David D.; Mann, Leland A. (to Energy Systems, Inc.). U. S. Patent 3,671,741. 20 Jun 1972. Filed 12 Jan 1970.

An irradiator apparatus is described which is designed to perform a sterilization treatment or like process on waste material especially in the liquid state such as sewage or general industrial waste wherein a radiation source in the form of radioactive material is utilized to eliminate various types of micro-organisms or other undesirable elements which are carried by the liquid waste material. The apparatus includes a structure comprising a plurality of parallel baffles arranged about a substantially centrally located core mounted within the casing and structurally designed to support a plurality of radioactive material elements serving as the radiation source. The core also includes a plurality of parallel baffles which communicate with the baffles of the casing to define a somewhat serpentine flowpath along which the liquid travels as it passes through the irradiator. (Official Gazette)

45457 IRRADIATION APPARATUS FOR PROVIDING A HIGH INITIAL IRRADIATION OF THE PRODUCT. Green, William R. (to Atomic Energy of Canada Ltd.). U. S. Patent 3,673,409. 27 Jun 1972. Priority date 6 Feb 1970, Canada.

Apparatus is described for the radioactive irradiation of products whose composition requires a relatively high intensity of irradiation for a short period followed by a relatively low intensity of irradiation for a longer period. In order to efficiently utilize the source, the product is passed into the center of a rack of source material and thereafter passed around the outside of the rack. The product is cooled by water during irradiation and the same water is used to effect rotation of the product. (Official Gazette)

Heat Transfer and Fluid Flow

Refer also to abstracts: 45427, 45435–45437, 45439, 45442, 45449, 45450, and 45721.

45458 (CISE-R-245) PDE: DIGITAL PROGRAM FOR THE CALCULATION OF THE THERMAL-HYDRODYNAMIC CONDITION IN A CIRCUIT OF A TWO PHASE MIXTURE WATER AND STEAM. Muscettola, M.; Barbieri, G. (Centro Informazioni Studi Esperienze, Milan (Italy)). Oct 1967. 175p. (In Italian). Dep. NTIS (U. S. Sales Only).

The digital program PDE (Pressure, Density, Energy) is described. It has been set up to compute the pressure conditions, the densities and the energy and mass content in a boiler. The hydraulic schemes which can be considered by the program are indicated. In input the program requires groups of data such as the constants of experimental correlations for pressure drops and steam volume fraction: the geometric characteristics and dimensions of the circuit through the number of zones, risers per zone, channels per riser, the number of cells, and for each cell its length, flow area, hydraulic diameter, direction of the flow, type of geometry, and type of discontinuity at the outlet extreme; and the thermal and hydraulic conditions imposed, i.e., the drum pressure and for each channel the mass flow rate, the inlet enthalpy (below as well as above saturation), and the thermal power transferred to the fluid specifying both the magnitude and the shape of the distribution along the channel (constant, sinusoidal, and defined in a discrete number of points). Program output consists of data on the pressure, the steam quality, volume fraction, and the density and enthalpy of the mixture at the inlet and at the outlet of each cell; for the heated channels, the mass flow rates which would determine the thermal-crisis at the outlet of each cell; for each section of the circuit (i.e., risers, unheated and heated channel) and for each zone, the mean density, the mass, mean energy, and total energy of the mixture and the internal volume of the circuit; for the heated section of the channel of each zone, the mean density in every cell and the mean density weighted on the square of the heat flux, the mean being taken over the whole heated section of the channel; for the whole circuit the mean density weighted on the square of the heat flux, the total mass and energy of the fluid, and the total volume of the circuit. The program is written in FORTRAN IV for IBM 7040. (auth)

45459 (CISE-R-275) THRESHOLD OF PARALLEL CHANNEL FLOW INSTABILITY. Masini, G.; Possa, G.; Tacconi, F. A. (Centro Informazioni Studi Esperienze, Milan (Italy)). Sep 1968. 57p. (In Italian). Dep. NTIS (U. S. Sales Only).

In the framework of the CIRENE Project, an experimental program was conducted by CISE on parallel channel flow instability. A forced convection open loop circuit was built. The circuit is composed of two parallel channels, simulating at a reduced scale the reactor power channels. Flow instability threshold data are presented and briefly analyzed. The mechanism of flow instability is clearly of a dynamic nature. (auth)

45460 VAPOR TRANSPORT LIMITS OF LIQUID METAL HEAT PIPES. DeMichele, Don W. (Texas A and M Univ., College Station); Davis, Monte V. Nucl. Technol.; 15: No. 3, 366-83 (Sep 1972).

The mass flow choking limits have been calculated for fourteen potential working fluids in cylindrical heat pipes. The problem is analyzed with the vapor assumed to be a perfect gas and then as a compressible gas with viscous flow and both results compared to measured heat pipe performance. Based on the measured data the analysis has been extended to other potential working fluids and the results are tabulated. (auth)

45461 EXPLOSIVE INTERACTION OF MOLTEN METALS INJECTED INTO WATER. Bradley, R. H.; Witte, L. C. (Univ. of Houston, Tex.). Nucl. Sci. Eng.; 48: No. 4, 387-96(Aug 1972).

A high-speed photographic investigation established the general nature of the explosive interaction between hot molten metal jets and subcooled (75°F) distilled water. The photographic sequences yielded basic information concerning the relationship between extent of material fragmentation and the intensity of explosive action. Prior theories for the explosive causative mechanism were shown to be inadequate to explain the observed explosive action. A thermally controlled initiating mechanism is hypothesized and the experimental evidence supports the hypothesis. Dimensional analysis yields a parameter dominated by the thermal characteristics of the jet system. (auth)

45462 EFFECT OF LATERAL ROD DISPLACEMENT ON LAMINAR-FLOW TRANSFER. Hsu, Chia-jung (Brookhaven National Lab., Upton, N. Y.). J. Heat Transfer; 94: No. 2, 169-73 (May 1972).

Heat transfer in longitudinal laminar flow through tightly packed rod bundles is analyzed for a rod displaced from its symmetrical position. The influences of the pitch/diameter (P/D) ratio, the magnitude of displacement/d_{max} (σ), and the type of thermal boundary condition on the variation of the coolant temperature field and the rod-average Nusselt number

are investigated. Average Nusselt numbers for the displaced rod are calculated for rod bundles with $1.00 \leq P/D \leq 2.0$ and $0 \leq \sigma \leq 0.8$. The results for the special case of $\sigma = 0$ (i.e., for symmetrical rod bundle) show excellent agreement with those reported by Dwyer and Berry, who analyzed numerically the corresponding problem for symmetrical rod bundles. (auth)

45463 RECENT DEVELOPMENTS IN THERMOPHYSICAL PROPERTIES RESEARCH. Winter Annual Meeting of the American Society of Mechanical Engineers, Washington, D. C., December 1, 1971. Cezairliyan, A. (ed.). HTD Vol. 3. New York; American Society of Mechanical Engineers (1971). 18p. $3.50. (CONF-711218).

Papers are included in which discussions are presented on thermal conductivity, thermal diffusivity, thermal expansion, and thermal radiation properties. Other thermophysical and related properties, such as specific heat, melting point, and electrical resistivity, are also reviewed in connection with discussions of technique. (J.R.D.)

45464 EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER FROM PARTIALLY IONIZED ARGON WITH AN APPLIED TRANSVERSE MAGNETIC FIELD. Roschke, E. J. (California Inst. of Tech., Pasadena). J. Heat Transfer; 94: No. 2, 174-80(May 1972).

Wall heat transfer measurements were obtained for laminar flow of partially ionized argon flowing within the conducting walls of a square channel, with and without an applied transverse magnetic field. Tests were conducted for subsonic flows and for flows which were supersonic before a magnetic field was applied. Increases in Stanton number by a factor of as much as six were observed at field strengths approaching 10 kG as compared with values at zero magnetic field. These large increases in heat transfer are believed to have been due to (1) a small amount of joule heating augmented or accompanied by (2) magnetically induced ionization. Heat transfer and flow data were used to estimate effective values of the joule heating parameter, Hall coefficient, and current density. The experimental data have been compared with theoretical predictions for several limiting cases. (auth)

45465 IMPROVED POINT-MATCHING TECHNIQUES APPLIED TO MULTI-REGION HEAT TRANSFER PROBLEMS. France, D. M.; Ginsberg, T. (Argonne National Lab., Ill.). J. Heat Transfer; 94: No. 2, 203-10(May 1972).

An analytical method is presented which extends the series solution of the Laplace and Poisson equations with irregular boundary conditions to multi-cell problems. The method employs a least-squares technique of satisfying the boundary conditions on the irregular boundaries and eliminates the use of a finite number of boundary points to satisfy these conditions. The technique is applied to the calculation of the fully developed temperature distribution of a constant-velocity fluid flowing parallel to a semi-infinite square array of circular nuclear fuel rods. The bounding wall of the array is located such that the flow area of the cell associated with the rod adjacent to the wall is different from the (equal) areas of all the other cells. The series solution is compared with a finite-difference solution for a sample case of two cells. The results for the semi-infinite array indicate that while the array temperature distribution is markedly affected by the difference in flow areas, the Nusselt numbers of the rods are relatively unaffected. Typical results are presented for a pitch-to-diameter of 1.2; the flow area of the first cell is 3.67 percent greater than the area of the other cells. (auth)

Materials Testing

Refer also to abstract: 45432.

45466 (AE-451) DEPTH DISTRIBUTION STUDIES OF CARBON IN STEEL SURFACES BY MEANS OF CHARGED PARTICLE ACTIVATION ANALYSIS WITH AN ACCOUNT OF HEAT AND DIFFUSION EFFECTS IN THE SAMPLE. Brune, D.; Lorenzen, J.; Witalis, E. (Aktiebolaget Atomenergi, Studsvik (Sweden)). 1972. 47p. Dep. NTIS (U. S. Sales Only).

Depth distribution studies of carbon in steel and iron were carried out in the concentration range 0.05 to 1%, using proton activation analysis. Surface content studies were performed in the concentration range 0.01 to 1% using deuteron activation analysis. The following reactions were utilized: $^{12}C(p,\gamma)^{13}N$ and $^{12}C(d,n)^{13}N$. Evaluations of depth distribution were based on resonances in the excitation function. The carbon content was determined with the aid of the positron emitter, ^{13}N, using either single-peak or coincidence measurements. The heat dissipation in the irradiated region of the samples was calculated, and the temperature rise was measured using thermocouples. The temperature distribution within the hot zone subjected to irradiation by charged particles, together with the temperature distribution around this zone, was studied in order to estimate any effect this might have on the carbon diffusion. A device for automatic sample exchange which is remotely controlled is described. (auth)

45467 (BNWL-SA-4320) ^{252}Cf NEUTRON RADIOGRAPHY AT BATTELLE-NORTHWEST. Swinth, K. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). [nd]. 4p. (CONF-720902-1). Dep. NTIS.

From National topical meeting on the applications of californium-252; Austin, TX. (11 Sep 1972).

Work devoted to development and use of ^{252}Cf in neutron radiography is described. Discussions are included on exposure facilities, imaging techniques, and applications. (J.R.D.)

45468 SENSITOMETRIC MEASUREMENTS OF NON-SCREEN INDUSTRIAL FILMS EXPOSED BY X OR GAMMA RADIATION. Smoniewski, J. Pomiary, Automat., Kontr.; 17: 202-3(1971). (In Polish).

The quality of a photographic image obtained by exposure of radiographic films with the aid of X or gamma radiation in industrial flaw detection technique has an important effect on the information about a part under test. This quality being dependent upon the quality of radiation, the effective energy of 85, 125 and 660 keV representing the range of practically applied exposures is selected for testing. A method of sensitometric measurement is described and numerical values of radiosensitivity and gamma indices are given. These data should facilitate the correct choice of the films and also proper exposure thereof. (NSA of Poland) (auth)

45469 ULTRASONIC FLAW DETERMINATION BY SPECTRAL ANALYSIS. Adler, Laszlo; Whaley, Hubert L. (to United States Atomic Energy Commission). U. S. Patent 3,662,589. 16 May 1972. Filed 2 Feb 1971.

A method of quantitatively determining the size and orientation of flaws within a material is given. A broadband pulse having a frequency width of at least several MHz is used for an input pulse from a transducer which is directed toward the test material which may contain a flaw, and the average frequency interval between interference maxima in the reflected spectrum is relatable to both the size and orientation of the flaw. An experimental method using two known angle changes allows determination of the size and angle of randomly oriented discontinuities within metal specimens. (Official Gazette)

45470 NONDESTRUCTIVE TEST FOR MEASURING THE STATE OF HEAT TREATMENT IN CLOSURE WELDS. Dodd, C. V.; Lu, C. C. (Oak Ridge National Lab., Tenn.). Mater. Eval.; 30: No. 7, 142-8(Jul 1972).

The first-stage development on a nondestructive testing technique to measure the properties of resistance-welded closures on chemical munition containers has been completed. A preliminary technique using a magnetic circuit has been developed that measures temper of the weld, cross-sectional area of the weld, and variation of cap height from nominal. Measurements of magnetic properties as a function of temper and area were made of samples of AISI Type 1040 steel. A prototype probe to induce the magnetic circuit, link the magnetic circuit through the weld and measure the magnetic flux through the circuit was designed and constructed. Tests performed on six sample welds demonstrated the capability for measuring the temper, area, and variations in cap height. Recommendations for improving the accuracy, speed, and reliability of the measurements are given. (auth)

45471 FACTORS GOVERNING RADIOGRAPHIC CRACK DETECTABILITY IN STEEL WELD SPECIMENS. Becker, George L. (E. I. Du Pont de Nemours and Co., Inc., Wilmington, Del.). Mater. Eval.; 30: No. 7, 149-52(Jul 1972).

The effects of energy level and radiation source position changes on crack detectability were evaluated on a crack in a steel weld. The weld was step-machined to present various crack depths on the radiographs. Steel plates were added progressively beneath this cracked wedge until the crack image was no longer discernible on the film. Both x and gamma radiation were used, and standard image quality indicators were added to correlate crack detectability with indicator sensitivity. Detectability parameters were established for the various energies and positions used. (auth)

45472 ULTRASOUND QUALITY CONTROL INSTALLATION. Boulanger, Gilbert; Samoel, Alain (to Commissariat a l'Energie Atomique). French Patent 2,088,972. 13 Dec 1971. Filed 30 Apr 1970. (In French).

An apparatus is presented for the quality control of metallic elements (in particular the fuel cans of nuclear fuels) by ultrasound. It consists of a non-sealed vessel in which the water level is maintained constant with the aid of a feed device de-

signed to avoid bubbles of air and turbulence in the vessel. The measurement vessel is of parallelepiped form and separated into three adjacent compartments by two parallel partitions. The two partitions and the sides of the vessel are provided with orifices which face one another and allow the passage of the fuel cans. The installation also possesses a means of moving the fuel cans, measurement transducers which are attached to the opposite faces of the vessel in the central compartment, and a system for feeding water into the vessel. (France)

45473 POSSIBILITIES OF USING RADIOISOTOPE INSTRUMENTS IN FABRICATION OF HIGH POWER PLANTS OF SUPERCRITICAL STEAM PARAMETERS. Lonskii, E. D.; Zorchev, S. N.; Volkov, O. S.; (and others). Izotopy SSSR; No. 22, 14-17 (1971). (In Russian).

The possibility of employing radioisotope methods for the inspection of welded joints of boilers with capacities of 300 000, 500 000, and more kW is considered. (tr-auth)

Nuclear Explosions

Refer also to abstracts: 45542, 45571, 45628, and 45674.

45474 (JAB-99-88) OBSERVATIONS OF CHIMNEY DAMAGE TO RESIDENTIAL BUILDINGS IN GLENDALE, CALIFORNIA: SAN FERNANDO EARTHQUAKE, FEBRUARY 1971. Farhoomand, I.; Scholl, R. E. (Blume (John A.) and Associates Research Div., San Francisco, Calif.). May 1972. Contract AT(26-1)-99. 36p. Dep. NTIS.

Statistical observations of residential chimney damage, resulting from the San Fernando earthquake, for a selected control area within Glendale, California, are summarized. The procedures used in performing a structure inventory and damage survey are described. General statistical observations are presented, the variation of damage for different chimney types is examined, and suggestions are made for increasing chimney resistance to ground motion disturbances. (auth)

45475 (NP-19361) DESIGN OF A WATERWAY CONNECTING THE ORINOCO AND RIO NEGRO RIVERS IN THE FEDERAL TERRITORY OF AMAZONAS, VENEZUELA. Technical Report No. 153. Paz-Castillo, Fernando A.; Kruger, Paul (Stanford Univ., Calif. Dept. of Civil Engineering). Jun 1972. 251p.

Development of the Federal Territory of Amazonas in Venezuela depends upon the construction of adequate facilities for inland bulk-cargo transportation. A major facility would be the extension of navigability for freight cargo along the Orinoco River deep into the Federal Territory. The extension of navigability can be further developed by an excavation of the divide between the Orinoco River and the Rio Negro River, a major tributary of the Amazon River in Brazil. A navigation waterway would greatly assist the economic development of the Federal Territory and provide a means for extended commerce between Venezuela and its neighboring countries Brazil and Colombia. The geographical properties of the divide region were examined and a suitable waterway was designed which can be constructed by modern explosive excavation methods. An alignment of about 62 km connecting the Atabapo River tributary of the Orinoco, with the Guainia River tributary of the Rio Negro appears to be economically feasible. Estimates from sparse hydrometerologic data indicate that sufficient flow exists to support a navigation channel with a minimum width of 77 m for barges of 3 m draught. It is estimated that the waterway could maintain an annual freight of 80 Mt. The waterway is designed for construction by a combination of high-energy chemical and nuclear explosions and appropriate blasting and dredging operations. The requirements for the selected alignment include a total of 92 kt high-energy chemical explosives for excavations less than 17 m deep, and 157 10-kt nuclear explosives for a 15.5 km excavation through the divide. The total cost of the waterway excavation, with present costs of chemical explosives and nuclear explosion service prices announced by the USAEC, is about $195,000,000. The mechanical and radiological safety of the excavation has been examined and no undue restrictions are apparent. The Federal Territory of Amazonas in its still virtually undeveloped state presents little population relocation problems. A schedule for detonations and reentry was prepared which can achieve the waterway construction over a period of four years. Construction of the waterway could be currently achieved under provisions of all existing international treaties; especially under Article V of the Non-Proliferation of Nuclear Weapons Treaty. The further continuation of this study could serve as a model project by the International Atomic Energy Agency to achieve the beneficial aspects of nuclear explosives sought by its member nations. (auth)

45476 (NVO-38-33) PROJECTED RESERVOIR PERFORMANCE. RIO BLANCO PROJECT. van Poollen, H. K. (van Poollen (H. K.) and Associates, Littleton, Colo. (USA)). Mar 1972. 88p. (PNE-RB-26). Dep. NTIS.

Data from three wells were analyzed to determine basic reservoir parameters and to predict a future reservoir performance assuming nuclear stimulation is carried out. Permeability, as calculated by pressure transient analysis, ranged from 0.0064 to 0.087 md in offset well Fawn Creek Government No. 1. Log analyses of RB-E-01 indicate an average porosity of 9.4%, average gas saturation of 57% and a net pay of 421 ft. The permeability from pressure transient analysis averages 0.025 md for the Fort Union and 0.011 md for the Mesaverde. This gives 7.75 md-ft for the Fort Union and 1.23 md-ft for the Mesaverde or a total of 8.98 md-ft. Reservoir performance was predicted using a single-layer model with an average permeability of 0.0212 md. Cumulative production after 25 years was 19.9 BCF for 640-acre spacing. A two-layer model using the calculated values for the Fort Union and the Mesaverde gave a 25 year cumulative production of 17.9 BCF. Additional predictions made using a range of permeabilities are also included. One value of pressure dependent permeability was run using 640- and 320-acre spacings. However, it is felt that the information used to determine the pressure dependent permeability was not necessarily valid and should not be given much consideration. (auth)

45477 (NVO-86(Rev.1)) REPORTS AVAILABLE IN PLOWSHARE OPEN FILE. (Nevada Operations Office (AEC), Las Vegas). May 1972. 33p. Dep. NTIS.

A list is provided of those publications concerning Gasbuggy, Rulison, Rio Blanco, and Wagon Wheel that have been placed in the Plowshare Open Files by the Nevada Operations Office of the USAEC. (L.C.L.)

45478 (NVO-409-1) ECOLOGY OF HOT CREEK VALLEY: VEGETATION AND SOIL RESPONSE TO UNDERGROUND DETONATION. Annual Progress Report FY 1971. Tueller, Paul T.; Bruner, Allen D.; Davis, J. Barry (Nevada Univ., Reno (USA). Max C. Fleischmann Coll. of Agriculture). 1971. Contract AT-(26-1)-409. 135p. Dep. NTIS.

An investigation is in progress on the influence of ground shock as a result of underground nuclear detonations on the soils and vegetation in Hot Creek Valley, Nevada. An ecological resource inventory of soils and vegetation has been completed to serve as a base for the determination of possible long-term vegetation changes. Seven plant associations and 30 soil families were mapped from ninety-four vegetation macroplots and soil descriptions. An estimation equation for grass, forb, and shrub production from shrub ring widths was developed to evaluate changes in vegetation production. By comparing growth estimations from ring width analyses with actual yields, the effect of a treatment (underground detonation) can be evaluated independent of yield differences caused by normal environmental fluctuations. Other studies are in progress on both treatment and control sites to help determine possible post-detonation changes. These include sap flow velocity measurements to compare with changes in soil moisture uptake rates in woody plants; plant phenology and productivity determinations to evaluate growth and developmental changes in the life cycle of plants; and photographic remote sensing with color infrared film for the analysis of plant vigor. Revegetation attempts using several species and methods of establishment and the influence of ground shock on other ongoing ecological studies are reported on. (auth)

45479 (NVO-746-122) MILROW/CANNIKIN SEISMIC EFFECTS. Engdahl, E. R. (National Oceanic and Atmospheric Administration, Rockville, Md. Environmental Research Labs.). May 1972. Contract AT(29-2)-746. 36p. Dep. NTIS.

Seismic effects of the underground nuclear explosions Milrow (October 1969, about 1 megaton) and Cannikin (November 1971, under 5 megatons) were monitored by a network of continuously-recording, high-frequency, high-gain seismographs located on Amchitka and nearby islands. Each explosion was immediately followed by hundreds of small discrete events ($m_B < 4$), of a similar focal mechanism and with a characteristic low-frequency signature, which apparently occurred as a result of the deterioration of the explosion cavity. This activity intensified, then terminated, within minutes of a large complex multiple event and concurrent formation of a surface subsidence crater, signaling complete collapse of the explosion cavity (Milrow, 37 hours; Cannikin, 38 hours). On a smaller scale, apparently unrelated to the collapse phenomenon, were a number of explosion-stimulated tectonic events which occurred intermittently for several weeks following each explosion near the explosion cavity and up to 13 km southeast of Cannikin ground zero along the Island. These events were confined to the upper crust of the Island, had characteristically high-frequency signatures, and, near the Rifle Range Fault, had focal mechanisms which correlated with pre-existing faulting. The evidence points to a short-term interaction of the explosions

with the local ambient tectonic stresses of the Island through explosion-generated elastic body waves or changes in fluid pore pressure. Continuous monitoring of the natural seismicity of the region since 1969 reveals no other apparent evidence for an interaction between either Milrow or Cannikin and natural tectonic processes. The high level of natural seismicity in the subduction zone from 20 to 60 km beneath the Island and the apparent low level of stress in the upper crust of Amchitka suggest that these zones are effectively seismically decoupled. (auth)

45480 (NVO–1163-TM-32) COMPARISON OF RESPONSE SPECTRA FROM YUCCA FLAT AND PAHUTE MESA UNDERGROUND NUCLEAR DETONATIONS. Lynch, Robert D.; Williams, Spencer L. (Environmental Research Corp., Las Vegas, Nev.). Jun 1972. Contract AT(29-2)-1163. 78p. Dep. NTIS.

The statistical techniques of regression analysis and covariance analysis are applied to response spectrum data from underground nuclear events detonated at the Yucca Flat area of the Nevada Test Site. In the case of regression analysis, estimates of yield and distance scaling exponents are determined. In the case of covariance analysis, only yield scaling exponents are determined. In both analyses, the deviation of observed response data from the assumed relationships among the variables is measured by the standard error of estimate. The results of the Yucca Flat analysis are compared with previous results of similar analyses of response spectrum data from Pahute Mesa detonations at the Nevada Test Site. Yield scaling exponents differ significantly for events in the two detonation areas. An analysis determines that the relatively heterogeneous emplacement environment at Yucca Flat compared to that of Pahute Mesa is responsible for the yield scaling discrepancy. (auth)

45481 (NVO–1163-TM-33) ANALYSIS OF SEISMIC WAVES RECORDED IN LAS VEGAS, NEVADA FROM UNDERGROUND NUCLEAR DETONATIONS. Davis, Lawrence L. (Environmental Research Corp., Las Vegas, Nev.). Jun 1972. Contract AT(29-2)-1163. 72p. Dep. NTIS.

The seismic data from Nevada Test Site detonations recorded on a comprehensive instrumentation array in Las Vegas, Nevada, were analyzed to study the propagation of the surface wave trains which contain significant amplitudes, to define the variations in response throughout the city and to relate these variations to known geologic and geophysical conditions. The propagation of the Rayleigh wave was examined and a simplified crustal model between NTS and Las Vegas was derived from the dispersion characteristics of the Rayleigh wave. A late arriving, large amplitude surface wave appears on the recordings in the southeast portion of the array. This wave apparently arrives from a direction other than radial and is possibly a Love wave because of the extremely small vertical motion. Peak amplitudes and spectral amplitudes are largest in the center of Las Vegas Valley, presumably because the alluvial fill is thickest in the center of the valley. Correlation of amplitudes and spectra with surficial geology and soil type was inconclusive. (auth)

45482 (NVO–1229-177) LONG TERM RELEASE OF RADIOACTIVITY FROM RAINIER MELT-GLASS. Essington, E. H. (Teledyne Isotopes, Las Vegas, Nev.). Oct 1971. Contract AT-(29-2)-1229. 21p. Dep. NTIS.

As a result of underground nuclear explosions much of the radioactivity produced is associated with melt-glass, formed partly as the condensation product of vaporized rock and device materials. Movement of these radionuclides away from the explosion zone by flowing ground water requires dissolution of the melt-glass and solubilization of the component radionuclides. Samples of melt-glass collected from the Rainier explosion zone at the Nevada Test Site were suspended in water of a chemical nature native to the area for periods of time ranging from a few minutes to nearly 4 years. Results of the study indicate that the major beta contributing radionuclides solubilized include ^{90}Sr, ^{137}Cs, and ^{125}Sb. At no time during the 4 year period were levels of these radionuclides found above reference Concentration Guide values specified for release of radioactivity to individuals or population groups in uncontrolled areas. (auth)

45483 (NVO–1229-180) DISTRIBUTION OF RADIOACTIVITY IN AND NEAR THE RAINIER RUBBLE CHIMNEY. Essington, E. H.; Forslow, E. J. (Teledyne Isotopes, Las Vegas, Nev.). Sep 1971. Contract AT(29-2)-1229. 91p. Dep. NTIS.

Underground nuclear explosions produce radioactive contaminants which can be transported with ground water. In order to accurately determine the variation in radioactive contaminant concentration in the hydrologic system in the vicinity of an underground nuclear explosion site, the initial spatial distribution and concentration of radionuclides in the cavity/rubble chimney complex must be known. An extensive analytical program was conducted to determine the spatial distribution of major radioactive contaminants in the one accessible rubble chimney, Rainier. Concentrations of the fission products ^{137}Cs, ^{90}Sr, ^{106}Ru, ^{144}Ce, and ^{125}Sb; and the activation products ^{134}Cs, ^{60}Co, $^{152-154}Eu$, and ^{55}Fe were measured on 5 identifiable rock types: melt-glass, contact melt, altered rubble, rubble, country rock, and an inseparable mixture of melt/rubble material. No data interpretation is given. (auth)

45484 (SC-DC–722296) LARGE SCALE CHARACTERIZATION TESTS OF GELLED SLURRY BLASTING AGENTS. Fastle, D. L.; Laursen, H. G.; Marker, T. F. (Sandia Labs., Albuquerque, N. Mex.). [nd]. 28p. Dep. NTIS.

A series of test events to characterize the large scale detonation properties of three gelled slurry blasting agents is described. The slurries chosen were DBA-22M, DBA-65T2, and DBA-105T2, all the claimed proprietary products of Intermountain Research and and Engineering Co. of Salt Lake City, Utah. It was also decided that the test series would include reference TNT devices in the same geometry, same charge weight, and as near the same density as is practical. Results of the tests indicate that DBA-22M and DBA-65T2 have considerable military potential as blasting agents. It is further concluded from other data available on DBA-22M that overpressure and impulse data, while very valuable, do not wholly account for the superior performance of this slurry agent over TNT in a more realistic military situation. It is also concluded that 65T2 has possibilities as a cratering or earth moving agent. (J.R.D.)

45485 (SC-RR–720359) CANNIKIN: EFFECTS ON ARCHAEOLOGICAL SITES. Merritt, M. L. (Sandia Labs., Albuquerque, N. Mex.). Jul 1972. 19p. Dep. NTIS.

Examination before and after Cannikin reveals that archaeological Site 32 suffered loss by cliff fall of about 45 m^2 of previously undisturbed midden area, as well as cave-ins of the walls of excavations made during the previous summer. Turf slides occurred along the outer slopes of the bluff on which Site 32 was located; a crack or incipient slide opened at Site 67; and cracks parallel to and just inward from the edge occurred in Sites 31 and 32 and probably elsewhere, but these slides and cracks only affected material that had already moved from its original position and thus had lost its archaeological context. AEC construction caused no damage to archaeological sites. (auth)

45486 (UCRL–51235) METHOD FOR ESTIMATING HEIGHTS OF WATER WAVES GENERATED BY UNDERWATER CRATERING EXPLOSIONS. Garcia, W. J. Jr. (California Univ., Livermore. Lawrence Livermore Lab.). 7 Jun 1972. Contract W-7405-eng-48. 10p. Dep. NTIS.

A method is described for predicting the wave heights of water waves generated by underwater cratering explosions. The method of predicting wave heights is based upon underwater explosion data, the results of numerical model simulations, and laboratory experiments. It was found that the ratio of wave height to source displacement is independent of the details of the displacement-time history of the source motion. A method for simulating water wave generation by underwater cratering explosions with a numerical model is also discussed. (auth)

45487 (UCRL–73939) CORROSION AND SCALING BY STEAM IN NUCLEAR GEOTHERMAL POWER PLANTS. Krikorian, Oscar H. (California Univ., Livermore. Lawrence Livermore Lab.). 2 Jun 1972. 36p. (CONF-720607–24). Dep. NTIS.

From eighteenth annual American Nuclear Society conference; Las Vegas, NV. (18 Jun 1972).

The quality of steam produced in a nuclear geothermal well will significantly affect the design, operation, efficiency, and expense of a steam-turbine powerplant. Problem areas related to steam quality are: the carrying and deposition of minerals (scaling) by steam, the carrying of radioactive contaminants by steam, the amount and types of noncondensible gases, and the corrosion of alloys. Minerals carried by steam are usually salts (such as NaCl, NaOH, or sodium silicates) and silica. Deposition of minerals in the piping or turbine can reduce flow, give inefficient turbine operation, or cause material damage to the turbine. The salt deposits are water soluble and can be washed away as an operational procedure. Silica, however, poses serious problems because of its insolubility. The maximum permissible concentration of silica in steam is about 0.05 ppM, in order to reduce silica deposition to a negligible level. If temperatures of 620°K and steam pressures of 80 atm were to be used, the silica content of steam would be about 9 ppM, i.e., more than 2 orders of magnitude higher than the maximum permitted concentration. It is clear that such impure steam would need to be purified, either by scrubbing with water or by some other means, before introducing it into the turbine. Radioactive contaminants from fusion or fission explosives that may be volatile after 180 days are given as the fission products: ^{85}Kr, ^{103}Ru, ^{106}Ru, ^{106}Rh, ^{125}Sb, ^{127m}Te, and ^{137}Cs; and induced activities: ^{3}H, ^{22}Na, ^{32}P, ^{35}S, ^{37}Ar, and ^{134}Cs.

For 1 Mt of yield, the amount of gamma radiation for the above species is 3.0×10^{16}MeV/sec for all-fission explosives, and 1.1×10^{15} MeV/sec for fusion explosives with 3 kt of fission. Fusion explosives also produce a high level of beta activity in the form of tritium. A thermodynamic model is used to roughly assess the volatilities of the main gamma emitters in steam. The approach used is to estimate the composition and amounts of volatile rock components and radioactivity retained in the steam when the major portion of the melted rock has cooled and separated from the steam phase. The radionuclide ^{85}Kr is, of course, a permanent gas while ^{125}Sb and ^{127m}Te are also expected to have high volatilities. For ^{103}Ru and ^{106}Ru, high volatilities are expected under oxidizing conditions with low volatilities expected under reducing conditions. The radionuclides ^{134}Cs and ^{137}Cs are believed to be significantly volatile, with their actual volatilities affected by the chloride and carbonate content of the rock formation. Radioactive impurities carried by steam are likely to coprecipitate with salts and silica in the turbine system, if the steam quality is poor. Noncondensible gases present in geothermal steam lead to three problems: enhanced corrosion to alloys; increased pumping costs to maintain turbine efficiency; and possible enhancement of carrying of minerals in steam. The noncondensible gas content of geothermal steam ranges from 0.01 to 5 wt %, with more typical values of 0.1 to 1 wt %. The gas CO_2 represents from 70 to 90% of the noncondensible gas. Next in importance are H_2S and H_2, with lesser amounts of CH_4, NH_3, and N_2. Limited information is available on the corrosion resistance of common alloys and other materials to geothermal water and steam. Tests have been performed on alloy coupons with water at 320 to 510°K and steam at 370 to 470°K for periods up to 150 days. The alloys most resistant to corrosion are titanium, austenitic stainless steels, and chromium-plated steels. Corrosion of alloys can occur from the presence of NH_3, H_2S, CO_2, and especially chlorides in steam. Also, corrosion is generally enhanced by the presence of oxygen. (auth)

45488 (USGS-474-148) GEOLOGIC AND HYDROLOGIC EFFECTS OF THE CANNIKIN UNDERGROUND NUCLEAR EXPLOSION, AMCHITKA ISLAND, ALEUTIAN ISLANDS, ALASKA. Amchitka-33. (Geological Survey, Denver, Colo.). Jun 1972. Contract AT(29-2)-474. 87p. Dep. NTIS.

The USGS studies related to the Cannikin Event included visible geologic effects, ground deformation measurement, analysis of high-speed motion photography, hydrologic effects, and a long-term program to analyze water on Amchitka Island for radionuclide content. Most visible effects were limited to an area within 2 km of ground zero. These included minor movement on faults, rockfalls and slumping along the sea cliffs, and about 1 m uplift along about 2 km of the Bering coastline. Displacement of less than 1 m occurred along a distance of about 600 m on two northeast-trending faults which lie 760 m southeast and 1,070 m northwest of GZ. The explosion cavity collapsed to the surface 38 hours after detonation forming an asymmetrical oval closed depression 915 × 1270 m in diameter and more than 10 m deep. The deepest point of the sink is 366 m southeast of GZ, which itself subsided only 5 m. Precise measuring of strain nets shows that a line 2 km long that trends northeast across GZ extended 1.2 m. Calculated strains decrease with slant distance from GZ out to a distance of 6 km. At that distance the strain was 2×10^{-6}. Principal strains show northeast-southwest extension. Flow of White Alice Creek, which drains the Cannikin site, has been reduced to about 4% of normal because of capture of most of the creek flow by the collapse sink. It is estimated that the chimney will fill in 1.5 years and that a lake 6 m deep will form in the sink before the normal flow of White Alice Creek can resume. The response of fluid pressures to the Cannikin Event was recorded in a number of boreholes, and a relation between fluid pressures (P) and slant ranges (R_s) has been established as $P = 963\ R_s^{-2.14}$. Chemical analyses of water collected on and around Amchitka after the event were compared with preevent analyses as part of a long-term program of radiochemical monitoring. No measurable increase in radioactivity has been detected. (auth)

45489 LONG-RANGE DETECTION AND LOCATION OF SOME SHALLOW-DEPTH EXPLOSIONS IN THE NORTHWEST PACIFIC. Northrop, John (Naval Undersea Research and Development Center, San Diego, Calif.). Bull. Seismol. Soc. Amer.; 62: No. 3, 793-803(Jun 1972).

During a survey of underwater explosions, a set of 382 closely-spaced events was located in the Northwest Pacific near the Emperor Seamounts. Later, it was learned that the shots were from a joint U. S.–Japan science cooperation seismic-refraction program. After-the-fact correlations were then made between the SOund Fixing and Ranging (SOFAR) fixes and shot-log data. Shots were composed of 3 to 288-lb Tetrytol or Seismogel demolition charges. Detonation depths varied from 60 to 420 ft. Results are that: (1) if only shots of 8.6 lb or greater are considered, a larger percentage (87.7) of shots composed of Seismogel was successfully located than of those composed of Tetrytol (59.5); (2) the threshold of detection was lower (9 lb at 90 ft as compared to 12 lb at 110 ft) in the northern part of the profile (37°N) than in the southern part (32°N); and (3) signals from shots detonated over the southern edge of the Shatsky Rise were received at a higher level than those detonated off the Rise. The reason for (1) is the higher detonating velocity of Siesmogel; for (2) it is the shoaling of the SOFAR channel with increasing latitude, and for (3) it is the effect of a highly reflective bottom which sloped toward the hydrophones. (auth)

45490 SEISMIC-SOURCE ENERGIES OF UNDERGROUND NUCLEAR EXPLOSIONS. Perret, William R. (Sandia Labs., Albuquerque, N. Mex.). Bull. Seismol. Soc. Amer.; 62: No. 3, 763-74(Jun 1972).

Records of particle velocity in the free-field geological environment near underground nuclear explosions may be interpreted to yield the energy flux at a measuring station near or within the region of elastic response of the rock. Such data from 21 events in several types of rock have yielded energy fluxes. Total energies associated with the motion propagated into the seismic region have been derived from all but seven of these. The total energies are a measure of the seismic-source strength, and the ratios of these energies to those released by the explosion are measures of the energy coupled into the Earth as seismic motion. Explosions in granite, dolomite, or wet tuff produce seismic sources of the order of 2% of the explosively released energy. Similar explosions in porous rocks such as dry tuff and desert alluvium provide seismic sources an order of magnitude weaker than those in hard or wet rock. (auth)

45491 ELASTODYNAMIC NEAR-FIELD OF A FINITE, PROPAGATING TENSILE FAULT. Haskell, N. A.; Thomson, K. C. (Air Force Cambridge Research Labs., Bedford, Mass.). Bull. Seismol. Soc. Amer.; 62: No. 3, 675-97(Jun 1972).

Displacement, particle velocity, and acceleration wave forms in the near-field of a finite, propagating tensile fault were computed by numerical integration of the Green's function integrals for an infinite medium. The displacement discontinuity (dislocation) on the fault plane is assumed to have the form of a unilaterally propagating, finite ramp function in time. Computer generated wave-form plots are presented for a variety of close-in locations with respect to the fault plane and for two different fault lengths. (auth)

45492 EXISTENCE OF NUCLEAR WEAPONS: A PRIME ENVIRONMENTAL THREAT. Gofman, John W. (Univ. of California, Berkeley). Environ. Aff.; 1: No. 4, 782-91(Mar 1972).

The environmental threat of the existence, not just the testing, of nuclear weapons is argued. The subjects discussed include the reasons why nuclear weapons exist, the political aspects of the nuclear arms race, the prospects for limiting or eliminating nuclear weapons, and the significance to the nuclear arms race and the environmental effects of the Cannikin test. (L.C.L.)

45493 NUCLEAR EXPLOSIVES AND HYDROCARBONS. Cohen, P. (CEA, Paris). Rev. Inst. Fr. Petrole Ann. Combust. Liquides; 26: No. 10, 927-34(Oct 1971). (In French).

The construction of a nuclear explosive device 12 in. in diameter which produces very little tritium is feasible in France. Such a device would be well adapted for contained nuclear explosions set off for the purpose of hydrocarbon storage or stimulation. The different aspects of setting off the explosive are reviewed. In the particular case of gas storage in a nuclear cavity in granite, it is demonstrated that the radiation dose received is small. (France)

45494 PREDICTION OF UNDERGROUND NUCLEAR EXPLOSION EFFECTS IN WAGON WHEEL SANDSTONE. Terhune, Robert W. (Univ. of California, Livermore). Nucl. Technol.; 15: No. 3, 431-46(Sep 1972).

Project Wagon Wheel is a study to investigate the technical concept of nuclear stimulation of a natural gas reservoir located near Pinedale, Wyoming. The results are presented of computer calculations, simulating the explosion effects, based on equation-of-state measurements of core samples taken from El Paso Natural Gas (EPNG) Wagon Wheel No. 1 hole at a depth between 8,000 to 12,000 ft. The shear failure envelope for Wagon Wheel sandstone is almost identical to that for Hoggar granite. A calculation for Wagon Wheel sandstone for one kt energy at a depth of 300 m duplicated cavity radius, shear fracture radius, stressed region, peak particle velocity, and peak acceleration data measured from the nuclear experiments conducted in the Hoggar granite by the French. The conclusion drawn from this comparison is that the Hoggar granite chimneys and regions of increased permeability provide a reasonable model to assume for Wagon Wheel. Cavity and chimney dimensions are predicted for a single explosive detonated at a depth of 10,000 ft. (auth)

45495 STUDY OF TRAVEL-TIME RESIDUALS WITH RESPECT TO THE LOCATION OF TELESEISMIC EVENTS FROM BODY-WAVE RECORDS AT MOXA STATION. Bormann, P. (Zentral-Institut Physik der Erde, Potsdam, Ger.). Gerlands Beitr. Geophys.; 81: No. 1-2, 117-24(1972).

From frequency distributions of travel-time errors based on focal data of the world data centers no exact quantitative parameters on the total travel-time deviation from the Jeffreys–Bullen (J–B) travel-time model can be obtained. The same holds for speed anomalies in the focal region. However, the difference of the systematic travel-time errors of various waves indicates travel-time differences of the waves that are not included in the J–B model. Interpretation of the causes is hereby often facilitated. Among other things, inferences can be drawn to anomal travel times in the region of the station or the reflecting region. When considering the systematic travel-time errors with inverse sign as a correction for the J–B travel times, then the accuracy of distance determinations and, hence, the accuracy of the location of seismic events by a single station can often be considerably increased. (auth)

45496 IDENTIFICATION OF TELESEISMIC EVENTS IN THE RECORDS OF MOXA STATION. Bormann, P. (Zentral-Institut Physik der Erde, Potsdam, Ger.). Gerlands Beitr. Geophys.; 81: No. 1-2, 105-16(1972).

Simple, efficient criteria for a routine identification of seismic events are given. With a minimum of technical and financial expenditure they enable earthquakes and underground nuclear explosions to be distinguished in the records of Moxa Station. In complex application, related to the signal-to-noise ratio (SNR), a very high identification rate is obtained. It corresponds about to the rate given in the literature for large station arrays. (auth)

45497 ELECTROMAGNETIC PULSE AND TIME-DEPENDENT ESCAPE OF NEUTRONS AND GAMMA RAYS FROM A NUCLEAR EXPLOSION. Sandmeier, H. A. (Los Alamos Scientific Lab., N. Mex.); Dupree, S. A.; Hansen, G. E. Nucl. Sci. Eng.; 48: No. 3, 343-52(Jul 1972).

The time-dependent escape of neutrons and gamma rays from a nuclear explosion is of interest in Plowshare and nuclear weapons effects investigations, particularly with regard to generation of the electromagnetic pulse (EMP). The neutron and gamma-ray leakage rates, spectra, and useful yield-related integral quantities are calculated for the 24 kt S-device. EMP parameters and fields at 500 m from the explosion of the S-device on the ground are presented and discussed. (auth)

45498 SEISMIC ARRAYS AND SEISMOLOGY. Husebye, Eystein S. Abstracts of Uppsala Dissertations from the Faculty of Science, No. 223. Uppsala; Univ. of Uppsala (1972). 13p.

Thesis.

The concept of seismic arrays, seismic data processing methods, signal parameter extraction, and applications of array data in seismological research are discussed. Information is included on both continental arrays and large aperture seismic arrays. (auth)

Protective Structures and Equipment

Refer also to abstracts: 46104, 46107, and 46108.

45499 RADIATION SAFETY AROUND THE HOT FACILITIES AT THE PINSTECH. Shaikh, Unis; Mubarak, M. A. (Pakistan Inst. of Nuclear Science and Tech., Rawalpindi). Nucleus (Karachi); 8: No. 4, 13-27(1971).

The hot facilities at the Pakistan Institute of Nuclear Science and Technology (PINSTECH) are described. These facilities include a 5-MW swimming pool-type reactor, nuclear chemistry, and nuclear materials laboratories. (auth)

45500 SOME OBSERVATIONS ON RADIATION SAFETY IN VIRGINIA DENTAL OFFICES. Mizeras, A. V. (Bureau of Industrial Hygiene, Richmond, Va.). Va. Dent. J.; 48: 26-33(Apr 1971).

The factors with which the Virginia Health Dept. is concerned in its radiation safety survey program are discussed. These include collimation, filtration, film badges, lead shielding, portable lead shields, lead aprons, cones, tube leakage, workload, timers, film speed and processing, positions of personnel during x rays, and the use of specialized x-ray equipment. (P.C.H.)

45501 PROCEEDINGS OF THE 1972 CLEAN AIR CONFERENCE, MELBOURNE, 15th–18th MAY 1972. Parkville, Australia; Clean Air Society of Australia and New Zealand (1972). 308p. (CONF-720541).

Forty-six papers on clean air were presented at the conference. A separate abstract was prepared for each of two. Forty-four papers are not within the scope of NSA. (L.C.L.)

For abstracts of individual papers see: 45502 and 45521.

45502 REMOVAL OF RADIOACTIVE IODINE FROM VENTILATION EXHAUST STREAMS AT THE AAEC RESEARCH ESTABLISHMENT. Bonhote, P. A.; May, G. G.; Polson, H. J.; Weir, R. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). pp 114-19 of Proceedings of the 1972 Clean Air Conference. Parkville, Australia; Clean Air Society of Australia and New Zealand (1972).

From International clean air conference; Melbourne, Australia (15 May 1972). See CONF-720541.

Since radioactive iodine is volatile, abundant in fission products, and selectively concentrated in the thyroid gland, it is usually the most important nuclide to be considered in assessing the risk of possible releases of fission products. At low mass concentrations in air, it forms many volatile organic compounds, the most abundant being methyl iodide. The elemental form is easily absorbed in activated charcoal, but the removal of methyl iodide at high humidities requires the use of special impregnated charcoals. The design criteria adopted at the Research Establishment are discussed and the absorption beds, the bed loader, bed housing, and handling procedures are described. The beds are tested at regular intervals, and results indicate a useful working life of one year. (auth)

ENVIRONMENTAL AND EARTH SCIENCES

45503 (COO–2195–6) PLANETARY TRANSPORT PROCESSES IN THE UPPER ATMOSPHERE. Annual Progress Report. Newell, Reginald E. (Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology). 31 May 1972. Contract AT(11-1)-2195. 16p. Dep. NTIS.

Results of research on fundamental processes which govern the structure, mass, and momentum of the upper atmosphere are reported. Lists of publications, theses, reports, and papers associated with the research are included. (J.R.D.)

Minerals and Ores

Refer also to abstracts: 45566, 45569, 45572, 46156, and 47300.

45504 PECULIARITIES OF FORMATION OF AN INCREASED URANIUM CONCENTRATION IN OXIDIZING CONDITIONS. Borkov, F. P.; Egorov, N. I.; Zaitsev, E. V. (Moscow Geological Inst.). Izv. Vyssh. Ucheb. Zaved., Geol. Razved.; No. 5, 51-7(1971). (In Russian).

The peculiarities of the formation of an enhanced U concentration under oxidizing conditions were examined. Similar concentrations are generally adapted to an oxidation zone of U deposits and are scarcely ever encountered in rocks with a Clark content of uranium. The U concentrations in oxidation zones of rocks with normal or somewhat increased Clark radioactive elements are usually adapted to regions of arid climate, and their formation is considered to be a result of an evaporative concentration of elements in ground waters (insolation). The U concentrations in the ore phenomena under consideration did not agree with these notions, but instead are examples of favorable geological conditions and geochemical circumstances. An epigenetic accumulation of U might occur under conditions of an oxidizing medium through its fixation in the hexavalent state. (tr-auth)

45505 DISTRIBUTION AND GENESIS OF RADIOACTIVITY IN COALS OF THE PECHORA RIVER BASIN. Gipsh, A. A.; Kapaturin, G. G.; Yudovich, Ya. E. Izv. Vyssh. Ucheb. Zaved., Geol. Razved.; No. 6, 61-70(Jun 1971). (In Russian).

The radioactivity of coals of the Pechora basin was studied in 77 samples chosen from mines of the Vorkutsk, Yun'-Yayinck, and Khal'mer'yu deposits. The content of the radioactive elements ranged between 0.4 and 10 g/T, was typically 2 g/T, and was related to the ash content. The essential carriers of radioactive elements in coal are the terrigenous components of ash—clay minerals. For low-ash strata, the increase of activity with increased ash content occurred more rapidly than high-ash strata. In Vorkutsk coals the fraction of activity due to uranium decreased with a rise in the ash content; the fraction due to potassium increases. The content of the potassium carrier (hydromica), with increase of ash content rose more rapidly than the U carrier (kaolinite). The Th content in these coals was extremely small. (tr-auth)

45506 PROBLEM OF EPIGENETIC ZONALITY IN URANIUM ORE DEPOSITS OF CARBONATE ROCKS. Shmariovich, E. M. Litol. Polez. Iskop.; No. 4, 105-16(Jul 1971). (In Russian).

The general characteristics of morphological features of uranium mineralization are provided by deposits in carbonate rocks and confirm their epigenetic character. In an instance of one of the deposits, an adaptation of the ore to an outcrop of an ancient reddish zone of stratified oxidation was observed. Study has substantiated the incompetence of the scheme of "oxygenless zonality" of uranium ore in carbonate oil-bearing rocks. Limestone recrystallization near ore zones is a result of secondary reestablishment of stratified-oxidized rocks in conjunction with the onset of gleyey (sic) water and petroleum. It is proposed that the intrusion of restoration fluids into carbonate rocks is accomplished along fracture zones. (tr-auth)

45507 SPECTROMETRY AND COMPUTERS USED FOR MAPPING DEPOSITS. Bland, Frederick. Aust. Mining; 64: No. 5, 56-7(May 1972).

A description is given of the airborne gamma spectrometric process as used for mapping uranium deposits in Australia. The theory behind the process is outlined and the installation of the 10 crystal spectrometer and computer processing of the data accumulated on tape are briefly described. (Australia)

45508 PRESENT STATUS AND PROSPECTS OF RADIOACTIVE ORE EXPLORATION IN YUGOSLAVIA. Com. Naz. Energ. Nucl., Notiz.; 18: No. 5, 38-40(May 1972). (In Italian).

A review of the present situation of uranium exploration and a description of ore deposits in Yugoslavia are presented. (auth)

Radioactive Effluents

Refer also to abstracts: 45398, 46102, 47401, 47404, 47413, 47424, 47435, 47446, 47465, 47471, 47473, 47479, 47486, 47487, 47489, 47497, 47498, 47502, 47510, 47516, 47518, 47532, 47534, 47535, 47543, 47545, and 47564.

45509 (KFK–1560) ENVIRONMENTAL BURDEN OF TRITIUM. Koenig, L. A. (Kernforschungszentrum, Karlsruhe (West Germany)). Feb 1972. 26p. (In German). Dep. NTIS (U. S. Sales Only).

A review is presented on the present state of knowledge with respect to the tritium burden on the environment. Following a compilation of the most important characteristics, the theoretical relationship between tritium incorporation and radiation burden is discussed. Sources of environmental tritium contamination are the tritium produced by nature and in nuclear fission reactors, the use of tritium-containing luminous colors, and, above all, the nuclear weapons tests. The tritium released undergoes a worldwide spread by the circulating water. The radiation burden due to this tritium contamination and evaluated by concentration measurements amounts presently to 0.1 mrem/g. An increase of this radiation burden is not anticipated until the year 2000. In case of realization of fusion reactors considerable attention will have to be paid to the tritium problem, since the tritium requirements of a fusion reactor amount to 4×10^5 Ci/MWy, while in the heavy-water reactor only about 10^3 Ci ^{3}H/MWy and in the light-water reactor about 10^1 Ci ^{3}H/MWy are produced. (auth)

Radioactivity Transport and Monitoring

Refer also to abstracts: 45205 and 47623.

45510 (AAEC/TM–627) ENVIRONMENTAL HAZARDS OF FOSSIL AND NUCLEAR POWER PRODUCTION. Watson, G. M. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). 1972. 20p. (CONF-720627–2). Dep. NTIS (U. S. Sales Only).

From Symposium on the role of nuclear energy in Australia's development; Canberra, Australia (1 Jun 1972).

It is now essential for engineers to recognize the environmental hazards which may be associated with their constructions and to make proper allowance for them when costing different solutions to a problem. Both nuclear and fossil-fueled power stations present environmental hazards, and these can be traced from mines through processing plants to power station wastes. It is necessary that engineers develop an appropriate basis of comparison if they are to assess the relative environmental costs of nuclear and fossil-fueled power stations; this must allow for effects on health, ecological effects, and aesthetic effects. The biological effects of radiation have been fairly well quantified with respect to major exposures, but there is still uncertainty on the precise form of dose-response relationships at low doses, such as might be relevant to industrial and public health. There are also uncertainties for non-radioactive pollutants, and it is probably not very logical to treat the dose-effect relationships of radioactive and chemical pollutants as being quite different in nature, as is commonly done at present. There are internationally accepted standards for allowable radiation exposure. It is possible to base allowable discharges of radioactive contaminants to the environment on these standards, provided the modes of dispersion are understood and possible pathways to the exposure of man are recognized. The philosophy of radiation protection recognizes that although radiation risks can be made very small, they cannot be abolished entirely, and that these risks must be balanced against the benefits of using radiation. These risks can be quantified and compared with other hazards of work and life which people accept, voluntarily or involuntarily. There are insufficient data available on the effects on health of various pollutants, and there is too little public agreement on the relative worth of mined and unmined natural resources, to allow a detailed comparison of the environmental hazards of nuclear and fossil-fueled power stations, but it is possible to begin this comparison in limited areas. (auth)

45511 (HASL–257) FALLOUT PROGRAM. Quarterly Summary Report, March 1, 1972–June 1, 1972. Hardy, Edward P. Jr. (New York Operations Office (AEC), N. Y. Health and Safety Lab.). 1 Jul 1972. 201p. Dep. NTIS.

Activities related to the HASL fallout program conducted during

the period from March 1, 1972 to June 1, 1972 are presented in nine sections. A separate abstract was prepared for each of the sections. (R.C.K.)

For abstracts of individual sections see: 45516–45519, 45525, 45526, and 45538–45540.

45512 (HASL–257(App.)) FALLOUT PROGRAM. Quarterly Summary Report, March 1–June 1, 1972. Appendix. (New York Operations Office (AEC), N. Y. Health and Safety Lab.). 1 Jul 1972. 437p. Dep. NTIS.

Data are given on ^{90}Sr and ^{89}Sr in monthly deposition at world land sites, radiostrontium deposition at Atlantic Ocean Weather stations, radionuclides and lead in surface air, and radiostrontium in milk and tapwater. A table of conversion factors and radionuclides of interest in the HASL fallout program are also listed. (P.C.H.)

45513 (UCRL–51242) ENVIRONMENTAL LEVELS OF RADIOACTIVITY IN THE VICINITY OF THE LAWRENCE LIVERMORE LABORATORY JANUARY THROUGH DECEMBER 1971. Gudiksen, P. H.; Lindeken, C. L.; Gatrousis, C.; Anspaugh, L. R. (California Univ., Livermore. Lawrence Livermore Lab.). 14 Jun 1972. Contract W-7405-eng-48. 47p. Dep. NTIS.

An environmental surveillance program is continuing in the Livermore Valley and Site 300 areas to determine to what extent, if any, the Lawrence Livermore Laboratory has contributed to the levels of radioactivity in the surrounding environment. The results of analyses for gross radioactivity and for specific radionuclides of interest in a variety of environmental samples are presented. Environmental levels of radioactivity were found to be below the concentration guide levels in AEC Manual Chapter 0524. Airborne particulate samples showed gross beta activities similar to those measured during previous years. Gamma spectral measurements of these samples revealed detectable activities of typical gamma emitters observed in global fallout, including fresh fission product debris from the 1970 Chinese and French nuclear weapons tests. Isotopic uranium analyses of airborne particulates collected at Site 300 indicated that the uranium was depleted in ^{235}U with respect to natural uranium. Soil samples collected within the Livermore Valley and Site 300 showed that the only activity contributed by the Laboratory was some low level ^{239}Pu contamination in one small on-site area and in one of the holding ponds at the Livermore Sewage Treatment Plant where the Laboratory's liquid effluent is processed. Samples of this effluent were also collected at various stages throughout the treatment plant to detect any possible build-up of activity within the facility. Gamma spectral analyses of milk and vegetation samples revealed no gamma-emitting radionuclides other than those present naturally or in global fallout. The results of the tritium analyses of vegetation samples revealed significant variation from one location to another which may be due to Laboratory operations. The activities of samples collected on-site and in off-site areas generally downwind from the Laboratory are up to 2 orders of magnitdue higher than those observed in areas where the Laboratory's contribution should be minimal. Water samples collected in the Livermore Valley exhibited normal gross beta and tritium activities, as did those from Site 300, except from one spring with water containing tritium activities that are about 4 orders of magnitude (but less than 1% of standard) greater than the others. Assessment of the doses to an individual from the observed environmental activities indicated the contribution from artificially produced radionuclides was small in comparison with that from natural processes. An adult in this area will receive less than 1 mrem/yr from the artificially produced radionuclides, with the exception of ^{144}Ce, which may deliver several mrem/yr to the organs of interest. (P.C.H.)

45514 GASEOUS PLUME DIFFUSION ABOUT ISOLATED STRUCTURES OF SIMPLE GEOMETRY. Meroney, Robert N.; Yang, Bing-tsuen (Colorado State Univ., Fort Collins). pp 1022-9 of Proceedings of the Second International Clean Air Congress. /Englund, H. M. (ed.). New York; Academic Press, Inc. (1971).

From second international clean air congress conference; Washington, D. C. (6 Dec 1970). See CONF-701229.

The state of gaseous dispersion prediction in the vicinity of buildings and results on the effects of building orientation, leakage location, and thermal stratification are reported. The study led to the following conclusions: dispersion patterns differ in regions with and without the presence of a building structure. The ground-level concentration variation with longitudinal distance in the wake region shows much flatter slopes than those in open fields; for a specific building orientation, dispersions are similar for different release ports (from the top, middle, and bottom of the building height). Strong turbulent mixing motions are believed to smooth out any effects from the origin of release; aerodynamic effects due to building orientations (0°, 45°, 90°, 135°, 180°) cause a slightly different concentration distribution in the cavity and near wake region. This difference depends on the portion of effluent which is initially carried downwind by convective motions; further downwind the dispersion will be independent of the original building shapes; mechanical turbulence dominates the dispersion behavior. The stratification becomes more important further downwind; inversion stratification causes about 8% higher ground concentration than obtained for neutral stratification; strong inversion stratification causes smaller transverse dispersion and "freezes" the plume growth in the vertical direction; and the plume growth in the transverse direction is about 3 to 5 times greater than that in the vertical direction for both neutral and stabilized stratified shear flows. (auth)

45515 DATA. SECTION IV. OTHER DATA. Radiat. Data Rep.; 13: No. 6, 377-84(Jun 1972).

Data are reported on off-site surveillance activities around the Nevada Test Site during July through Dec. 1971 including measurements of the gamma dose rates at 13 locations and the maximum ^{131}I content measured in off-site milk samples; gamma radioactivity in the environs of the Brookhaven National Laboratory during Jan. to July 1968; gross beta radioactivity in liquid waste effluents at the BNL site boundaries during Jan. to July 1968; and the location of existing and proposed U.S. nuclear power plants. (L.C.L.)

Atmosphere

Refer also to abstracts: 45501 and 45861.

45516 (HASL–257, pp I,2-17) MERIDIONAL TRANSPORT OF ^{90}Sr IN THE TROPOSPHERE. Servant, J. (Centre de Physique Atomique, Toulouse); Hoang, C. T. 1 Jul 1972.

In Fallout program.

Data on ^{90}Sr concentrations in surface air and in fallout, put in U.S.A.E.C. Health and Safety Laboratory, have been analyzed to interpret the dispersion of ^{90}Sr in the troposphere during the moratorium 1963 to 1965. Different processes, such as eddy diffusion, mean meridional motion, and stratospheric-tropospheric exchange were examined in relation with this analysis. At low latitudes, of both hemispheres, the distribution of ^{90}Sr, for the most part, can be accounted for by a meridional circulation. In the midlatitude (30-60°N–20-60°S), the direct injection from the stratosphere seems to play a major role in the distribution observed. Some difference in the behavior of ^{90}Sr in the southern hemisphere appears to result from an additional source in the upper troposphere of the southern equatorial zone, due to the interhemispheric exchange. At 70–80°N, in winter, a transfer of ^{90}Sr at the ground level from the midlatitudes is suggested. (auth)

45517 (HASL–257, pp I,18-32) HIGH FALLOUT IN THE WESTERN UNITED STATES. An Explanation. Volchok, H. L. 1 Jul 1972.

In Fallout program.

Through analysis of the ^{90}Sr concentrations in precipitation at conterminous U. S. sites, plus ^{90}Sr, ^{137}Cs, and ^{239}Pu data in surface air, several hypotheses for systematically high fallout in the western U. S. can be rejected. The most plausible explanation, consistent with all of the data, requires a preferential longitude for stratosphere-troposphere exchange at about 110° (west). This is close to the longitude of Salt Lake City, Utah, and with this mechanism, essentially all of the high ^{90}Sr fallout at that location is reasonably understood. (auth)

45518 (HASL–257, pp I,33-50) UPDATING STRATOSPHERIC INVENTORIES TO JULY 1971. Krey, P. W.; Krajewski, B. T. 1 Jul 1972.

In Fallout program.

The stratospheric inventories of ^{90}Sr, ^{95}Zr, and ^{137}Cs are reported to July 1971. The average $^{137}Cs/^{90}Sr$ ratio calculated from the inventories in each hemisphere during 1970 and 1971 (1.45) agreed with the theoretical production ratio of 1.44. Revised calculations indicated that the Chinese test of 10/14/70 and the large French tests of 5/31 and 7/5/71 injected into the stratosphere about 200 and 240 kCi of ^{90}Sr, respectively. Approximately 40 kCi of ^{90}Sr was injected into the Southern Hemisphere stratosphere probably by the intermediate yield French test of 6/12/71. (auth)

45519 (HASL–257, pp III,53-8) PROTECTION SERVICE, SITE SURVEY AND METEOROLOGY SECTION. Quarterly Report. (EURATOM Joint Nuclear Research Centre, Ispra, Italy). 1 Jul 1972.

In Fallout program.

Data are given on ^{90}Sr, ^{89}Sr, ^{137}Cs, ^{239}Pu, and ^{238}Pu contents in air and wet and dry deposition at Ispra for Sept. 1971 through

March 1972 and ^{90}Sr content in milk at Ispra for 1960 through 1971. The chemical procedures and counting techniques used are described. (P.C.H.)

45520 (NP–19357) COMPILATION OF THE RESULTS OF MONITORING ^{90}Sr AND ^{137}Cs DUE TO FALLOUT IN THE ARGENTINE REPUBLIC. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Division Estudios Ambientales). 1972. 11p. (In Spanish). (RS–34/66). Dep. NTIS (U. S. Sales Only).

For more than ten years systematic measurements on the levels of contamination of the Argentina biosphere due to radioactive fallout have been carried out. The results of these measurements with reference to strontium-90 and cesium-137 are given. (tr-auth)

45521 DEPENDENCE BETWEEN RADIOACTIVITY AND CONCENTRATION OF ATMOSPHERIC AEROSOLS. Glowiak, Bohdan J.; Palczynski, Ryszard J. (Technical Univ., Wroclaw). pp 155-61 of Proceedings of the 1972 Clean Air Conference. Parkville, Australia; Clean Air Society of Australia and New Zealand (1972).

From International clean air conference; Melbourne, Australia (15 May 1972). See CONF-720541.

An investigation of the natural radioactivity of atmospheric aerosols and the degree of dust concentration in the air in the Wroclaw area was carried out over a two-year period. Air was pumped through a blotting paper band filter and the radioactivity of precipitated aerosols was measured by means of a Geiger–Mueller counter. It was found that the solid air pollutants showed radioactive properties, caused, first of all, by the presence of natural isotope products of radon and thoron decay. Radioactive concentrations within the limits from 0.05×10^{-10} to 12.18×10^{-10} $\mu Ci/cm^3$ with a mean value of 1.7×10^{-10} $\mu Ci/cm^3$ were observed. The concentration of aerosols in the air investigated was measured by means of a photometric method which determined the degree of filter blackening. Measurements were expressed in dimensionless units based on a pattern scale. The summer and winter measurement results are discussed separately. Correlation coefficients, standard deviations and the parameters of the regression equations of each measurement series were calculated. The investigation showed that the dependence between the concentration of atmospheric aerosols and their radioactivity could be described by exponential equations with correlation coefficients ranging from 0.708 to 0.853. (auth)

45522 ESTIMATION OF THE TURBULENT DIFFUSION COEFFICIENT AND VERTICAL COMPONENT OF WIND VELOCITY ACCORDING TO NATURAL RADIOACTIVITY DISTRIBUTION. Amiranashvili, A. G.; Okroashvili, G. G.; Khundzhua, T. G. (Inst. of Geophysics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 66: No. 3, 585-7(Jun 1972). (In Russian).

A formula was obtained for determining the turbulent diffusion coefficient and vertical component of wind velocity. The calculations were made under the premise that the Rn present was in equilibrium with its decay products. Values were estimated for territory of Georgia, USSR. (auth)

45523 DATA. SECTION III. AIR AND DEPOSITION. Radiat. Data Rep.; 13: No. 6, 367-76(Jun 1972).

Data for Feb. 1972 on the gross beta radioactivity in surface air and atmospheric precipitation sampled at 70 U.S., 24 Canadian, and 12 Pan American sampling stations and at 14 air sampling stations in California are presented. (L.C.L.)

45524 STUDIES OF THE METEOROLOGICAL INFLUENCES ON ATMOSPHERIC RADIOACTIVITY AND ELECTRICITY AT GROUND LEVEL. Israelsson, Sven. Abstracts of Uppsala Dissertations from the Faculty of Science, No. 200. Uppsala; Univ. of Uppsala (1972). 36p.

Thesis.

The influences of meteorological conditions upon the atmospheric radioactivity and its connection with the atmospheric-electric phenomena near the ground were studied. The subjects discussed are divided into four categories; exhalation of radon from the ground; natural radioactivity in the air near the ground; artificial radioactivity in the air near the ground, and the relation between atmospheric electric conductivity and radioactivity in the air near the ground. Summaries are presented of ten papers entitled: natural radioactivity in the soil gas and exhalation of natural radioactivity from the ground surface; radon and thoron in the air near the ground; natural α-activity in the air near the ground; measurements of the β-activity in the air near the ground; natural β-activity in the air near the ground; meteorological influences upon the artificial β-activity in the air near the ground; measurements of the natural β-activity and the atmospheric polar conductivity at ground level; variations of electric conductivity and small-ion density in the air near the ground; and conductivity and concentration of small-ions in the air near the ground. (L.C.L.)

Soil

45525 (HASL–257, pp I.71-94) ^{90}Sr FALLOUT IN UTAH. Hardy, E. P.; Volchok, H. L.; Krey, P. W. 1 Jul 1972.

In Fallout program.

The annual deposition rate of ^{90}Sr (mCi per km^2 per year) derived from monthly precipitation samples was the same at Salt Lake City and New York City from 1957 to 1971. ^{90}Sr deposition concentrations (mCi per km^2 per cm of rain) based on soil analyses up to 1971 were higher in Salt Lake City and other regions of Utah than in other areas of the United States. These data along with ^{89}Sr to ^{90}Sr ratios at appropriate sampling locations indicated that the stratosphere is the major source of ^{90}Sr fallout in Salt Lake City, although about 16 mCi per km^2 or 10 percent of the ^{90}Sr debris probably came from activities at the Nevada Test Site prior to 1957. A limited topographic study in Utah in 1971 indicated that the highest ^{90}Sr deposition concentrations were found at sites closest to the windward side of a mountain front whereas the lowest concentrations were found at high elevation sites within the mountain range. However, it is believed that topography plays a minor role and the preferential stratospheric intrusions are more likely the cause of the high deposition concentrations in Utah. (auth)

45526 (HASL–257, pp I.95-118) PLUTONIUM FALLOUT IN UTAH. Hardy, E. P.; Krey, P. W.; Volchok, H. L. 1 Jul 1972.

In Fallout program.

Accumulated plutonium fallout in the north central and southeastern sections of Utah was measured in soil samples collected in June 1971. The maximum values in Utah of the deposition (mCi ^{239}Pu and ^{240}Pu per km^2) and deposition concentration (mCi per km^2 per cm of precipitation) were 2.2 and 3.8 times the maximum values found anywhere else in the United States. By comparing the $^{239,240}Pu$ to ^{90}Sr activity ratios of the Utah soils with the average activity ratio of 32 Northern Hemisphere soils collected in 1970–71, it was estimated that up to 60 percent of the total $^{239,240}Pu$ activity deposited at some Utah sites was from a source other than the stratospheric reservoir. Soil samples taken at a site near the University of Utah from 1959 through 1971 revealed that the excess plutonium was delivered prior to 1959. Mass isotopic analyses indicate that the Nevada Test Site is the probable second source and that about 3.5 mCi $^{239,240}Pu$ per km^2 or twice the level expected from global fallout, deposited in the Salt Lake City area from NTS. Excess plutonium was not evident at sites north of Salt Lake City and due east in the valley regions beyond the Wasatch range. (auth)

45527 (TID–26103) MEASUREMENT OF RADIOACTIVE FALLOUT BY FIELD TOTAL ABSORPTION GAMMA RAY SPECTROSCOPY. Report No. 3. Foote, R. S. (Texas Instruments Inc., Dallas. Science Services Div.). 30 Sep 1964. Contract AT(40-1)-3147. 75p. Dep. NTIS.

One and three-fourths years of continuous operation of the field gamma ray spectrometer has demonstrated: gamma ray emitting fission product fallout may be accurately measured and results reported within approximately 24 hr; near-surface amounts of the natural gamma emitters ^{214}Bi, ^{208}Tl, and ^{40}K can be measured with sufficient precision to study quantitatively the effects of surface water absorption, diurnal variations caused by meteorological effects on radon gas diffusion up to the ground surface and the fallout of radon daughter elements in rain showers; instrumental errors can be minimized by computer correction of the data by internal calibration using photopeaks which appear in all spectra; the ^{214}Bi can show daily variations as great as 100% caused by the diurnal radon "breathing" of the soil; absorption of natural gamma radiation from soils by increased soil moisture content is much greater than absorption of artificial fallout radiation which originates within a thin surface layer; the components of the field spectra have been adequately identified and accounted for down to a photopeak energy of 0.5 MeV, as shown by the residue spectra; ^{54}Mn and ^{125}Sb have been determined to be (or to have been) present in the gamma ray environment; and the region in energy about 0.5 MeV is believed to be a mixture of emitters which provide 0.5 MeV plus amounts of other gamma energies. Basically this is believed to be annihilation radiation from near-surface sources and from cosmic radiation as well as from ^{106}Rh and ^{103}Ru. The majority of this radiation has been considered to be annihilation radiation for the data reduction. Fallout measurements during the first half of the calendar year 1964 indicate that: no fallout of newly created isotopes occurred; $^{144}Ce-^{144}Pr$ and $^{95}Zr-^{95}Nb$ continued to decay according to their respective half lives during periods of no rain; ^{137}Cs continued to increase; ^{54}Mn has increased very slightly over the last one and one-half years; and ^{125}Sb has increased 41% since 1 Jan. 1964. Comparison of the matrix and least squares data reduction methods indicated that: the matrix technique is the most efficient in analyzing fallout data

where the components have half-lives greater than several days and may be identified by study of successive residue spectra; and the more time consuming and complex least squares method is best applied with less well known mixtures involving isotopes with shorter half lives. Analysis of data based on the 11 × 11 matrix reduction and upon a single record per day shows the pattern of buildup and decay of fallout radioisotopes detected over the one and one-half year period. (auth)

45528 DEPENDENCE OF IODIDE SORPTION ON VARIOUS SOIL COMPONENTS. Knaelmann, M. (Technische Univ., Hanover). Atomkernenergie; 19: No. 4, 329-32(1972). (In German).

The sorption of radioiodine from aqueous sodium iodide solutions by soils, which is important from the view of radiation protection, depends on the iodide concentration and the kind of soil. Data of previous experiments are used to test the relationship between several soil characteristics and the relative sorption. The method for determining the anion exclusion volume, which was used to calculate the sorption data, is compared with another method. The partial correlation coefficients calculated by these sorption data and the significant correlations are shown. (auth)

45529 GAMMA RADIATION OF SOME PLANTS AND SOILS FROM A URANIFEROUS AREA IN NEW ZEALAND. Whitehead, Neil E.; Brooks, Robert Richard; Coote, G. E. (Massey Univ., Palmerston North, N. Z.). N. Z. J. Sci.; 14: No. 1, 66-76(1971).

The amounts of several γ-emitters in plants and associated soils from a uraniferous area were determined by γ spectrometry with the use of a germanium detector operating in the low energy region. The following isotopes were absorbed by plants: ^{210}Pb, ^{227}Ac, ^{238}U, and ^{226}Ra. The average plant soil ratios (dry wt) were 0.092, 0.170, 0.197, and 0.815, respectively. The contribution of each radionuclide and its daughters to the radioactivity of the plant samples was 2.2, 3.3, 81.5, 1.9, and 10.4%, respectively. The remainder, 0.7%, was due to ^{228}Th and its daughters. (Euratom)

Water

Refer also to abstract: 45924.

45530 (BNWL-SA-4205(Rev.)) OCEANIC DISTRIBUTIONS AND RELATIONSHIPS OF ^{7}Be AND FISSION PRODUCTS. Silker, W. B.; Young, J. A.; Petersen, M. R. (Battelle Pacific Northwest Labs., Richland, Wash.). 1972. 18p. (CONF-720708-6). Dep. NTIS.

From Symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, WA. (10 Jul 1972).

The vertical and horizontal distribution of ^{7}Be in the world's oceans provides a potential basis for estimation of the distributions of other conservative fallout radionuclides as a function of time and space. Such information is essential to any study of biogeochemical processes occurring within the marine biosphere. Surface air concentrations of ^{7}Be, a cosmogenic radionuclide, vary seasonally with the northern hemisphere maximum occurring during June and the minimum in December, however the concentrations are uniform from year to year. If the transfer of ^{7}Be across the air-sea interface is proportional to its air concentration, then ^{7}Be in surface water should parallel the seasonal atmospheric fluctuation, and the water column would reflect the transfer during the preceding months. The ratio of the surface concentration of ^{7}Be to its water column inventory, for twenty-one northern hemispheric profiles, did indeed exhibit a strong seasonal change which was independent of latitude, longitude, and year of sampling. Highest ratios were observed during July and August and the lowest during the early spring months, in accordance with the pattern that would be predicted from the variation in air concentration. It is estimated that the ^{7}Be water column inventory can be determined within ±10% at the 95% confidence limits from a single measurement of the surface water concentration, and the annual deposition of ^{7}Be be approximated within ±20%. Oceanic deposition of a given fission product radionuclide should be directly related to the proportionality between its measured air concentration and that of ^{7}Be. Thus, the cumulative input of fission products with half-lives comparable to ^{7}Be could be determined by applying the time integrated ratios of fission product to ^{7}Be air concentration to the measured concentration of ^{7}Be in surface seawater; this would require appropriate corrections for relative decay rates and vertical mixing within the water column. A more complicated system occurs in the case of longer lived fission products because advective water mass transport becomes an important factor in the oceanic distributions. Eventually, air concentration ratios of fission products and ^{7}Be, together with surface water concentrations of ^{7}Be would be employed in a dynamic model of ocean mixing and circulation to predict the temporal and spatial distributions of long-lived radionuclides in the north Pacific Ocean. Once completed and verified, this model should provide a useful tool for predicting future oceanic distributions of radioactivity from nuclear weapons testing. (auth)

45531 (COO-3563-3) CONCENTRATIONS AND DISTRIBUTIONS OF LONG-LIVED FALLOUT RADIONUCLIDES IN OPEN OCEAN SEDIMENTS. Noshkin, V. E.; Bowen, V. T. (Woods Hole Oceanographic Institution, Mass.). 1972. Contract AT-(11-1)-3563. 22p. (CONF-720708-4). Dep. NTIS.

From Symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, WA. (10 Jul 1972).

Analyses of deep open-ocean sediment cores from the north and south Atlantic and the Mediterranean Sea showed the presence of ^{90}Sr, ^{137}Cs and ^{239,238}Pu in measurable amounts distributed to depth within the sediment columns. Comparison of the quantities of these radionuclides accumulated in the sediments with either estimated integrated deliveries to the sea surface or the measured inventories in the overlying water masses has been used to estimate the residence times of the radionuclides in the water column. For ^{90}Sr and ^{137}Cs these computed residence times were orders of magnitude shorter than those estimated for the stable elements. Plutonium was removed from the water column significantly more rapidly than either ^{90}Sr or ^{137}Cs. The ratio of ^{137}Cs to ^{90}Sr in the sediments was higher than that found in precipitation, suggesting that a larger fraction of ocean water ^{137}Cs is associated with sedimenting particles than has been previously assumed. A simple model assuming plutonium to associate with a mixed population of particles, sinking at rates of 392 to 70 m per year, predicts very well both the relation of sediment inventory of plutonium to depth of sediment, and the plutonium distribution vertically in the water column. (auth)

45532 ^{90}Sr IN THE GREAT LAKES: CONCENTRATION-TIME MODEL. Lerman, Abraham (Northwestern Univ., Evanston, Ill.). J. Geophys. Res.; 77: No. 18, 3256-64(20 Jun 1972).

Concentration-time models for ^{90}Sr in the Great Lakes deal with transient concentrations of a radionuclide in a chain of mixed lakes and in a chain of periodically stratified lakes. In the model, the lakes receive time-dependent input of ^{90}Sr from atmosphere and land (0 to 10% of annual deposit in the land drainage basins). Removal of ^{90}Sr from lake water is by outflow and decay. In the five Great Lakes computed concentrations of ^{90}Sr rise from nil (assumed) in 1953 to a maximum in 1964 to 1965, followed by a gradual decline until 1969. Computed concentrations are comparable to the range of reported values. However, a closer agreement between the model and reported concentrations requires the rates of input in 1962 to 1964 to be higher than the mean, as well as the rates of removal to be faster (by 6 to 8%) than the removal by decay and mean outflow. Seasonal stratification of the lakes has virtually no effect on mean annual concentrations of ^{90}Sr. (auth)

45533 SHALLOW-WATER ^{90}Sr ANOMALY ABOUT THE ANTILLES ARC, 1970. Bowen, Vaughan T.; Metcalf, W. G.; Burke, John C. (Woods Hole Oceanographic Institution, Mass.). J. Mar. Res.; 30: No. 1, 112-20(5 Jan 1972). (NYO-2174-124).

Vertical profiles about the southeastern approaches to the Caribbean in early 1970 have shown a consistent ^{90}Sr inversion, with the maximum concentrations at depths of about 100 m. It appears that four water masses may be involved in this area, in a very complicated mixing and overlayering phenomenon. (auth)

45534 RADIOLOGICAL SURVEYS OF PEARL HARBOR, HAWAII, AND ENVIRONS, 1966-1968. Cahill, Daniel F.; Harvey, H. D. Jr.; McCurry, D. C.; (and others) (Eastern Environmental Radiation Lab., Montgomery, Ala.). Radiat. Data Rep.; 13: No. 6, 323-34(Jun 1972).

From Apr 1966 through June 1968, the Eastern Environmental Radiation Laboratory of the Environmental Protection Agency (formerly the Southeastern Radiological Health Laboratory, Bureau of Radiological Health, U.S. Public Health Service) conducted radiological surveys of a number of U.S. ports which service nuclear-powered submarines. These surveys were undertaken to determine whether nuclear submarine operations, which include berthing, repair, and servicing, had resulted in radioactivity levels in the harbor which could contribute a detectable radiation exposure to the public. Six surveys were conducted at five ports with histories of extensive nuclear vessel activities, namely: Thames River, New London, Conn.; Hampton Roads, Va., including Portsmouth, Norfolk, and Newport News, Va.; San Diego Harbor, Calif.; Mare Island Naval Shipyard, Vallejo, Calif.; and Pearl Harbor, Hawaii. The conduct of the onsite surveys performed at Pearl Harbor in 1966 and 1968 is described and the results of the laboratory analyses of numerous environmental samples are pre-

sented. It is concluded that: small but detectable quantities of ^{60}Co were found exclusively in the sediment phases of the harbor; neither the harbor water nor any other environmental samples contained detectable ^{60}Co activity; the total amount of ^{60}Co in the harbor sediment is small compared to the natural radioactivity present in Pearl Harbor and decreased significantly from 1966 to 1968; the levels of ^{60}Co activity in the harbor were well below levels that could contribute a detectable radiation exposure to the public and do not constitute a hazard to public health or the environment; and investigation of the physical and chemical characteristics of ^{60}Co in marine sediments indicates that ^{60}Co and possibly other neutron-activated corrosion products are released in a form which is not biologically available to marine or other forms of life. (auth)

45535 RADIOACTIVITY IN LAKE MICHIGAN WATER AND BIOTA, VICINITY OF BIG ROCK POINT NUCLEAR REACTOR, 1960–69. Fetterolf, Carlos M. Jr.; Seeburger, D. James (Michigan Dept. of Natural Resources, Lansing). pp 211-18 of Proceedings of the Fourteenth Conference on Great Lakes Research. Ann Arbor, Mich.; International Association for Great Lakes Research (1971).

From fourteenth conference on Great Lakes research; Toronto, Ontario, Canada (19 Apr 1971). See CONF-710431.

Since two years prior to the startup of the Big Rock Nuclear Plant the aquatic biota has been monitored for gross β radioactivity at the discharge and at two remote control stations. Background levels, which were similar at all stations prior to criticality, fluctuated due to atmospheric fallout from nuclear weapon testing. Since criticality, radioactivity of aquatic biota at control stations has gradually decreased to near the minimum preoperational levels while radioactivity of biota in the discharge vicinity has gradually increased to near or slightly above the preoperational peaks caused by weapon testing. Surface water samples have been collected statewide and analyzed for gross β radioactivity during the past nine years. Radioactivity of surface water in the reactor vicinity is similar to that at other Michigan locations. (auth)

45536 RADIONUCLIDE CONCENTRATIONS NEAR THE BIG ROCK POINT NUCLEAR POWER STATION. Nelson, Donald M.; Romberg, Gerald P.; Prepejchal, William (Argonne National Lab., Ill.). pp 268-76 of Proceedings of the Fourteenth Conference on Great Lakes Research. Ann Arbor, Mich.; International Association for Great Lakes Research (1971).

From fourteenth conference on Great Lakes research; Toronto, Ontario, Canada (19 Apr 1971). See CONF-710431.

During the summer and fall of 1970, the concentrations of gamma-ray emitting nuclides were determined in samples of water, sediments, and organisms collected near the Big Rock Point reactor (Charlevoix, Michigan). Reactor-produced ^{65}Zn, ^{137}Cs, ^{134}Cs, and ^{60}Co were measurable at distances of up to a few kilometers along the shore in crayfish, water snails, Potamogeton sp., Ranunculus sp., Chara sp., Cladophora sp. and periphyton. In general, concentrations at 1 km are less than one-tenth those found in the same organism at the discharge point, with somewhat higher concentrations being found toward the east (into little Traverse Bay). Water and bottom samples were found to be quite variable, with concentrations in bottom sands being somewhat lower than the concentrations in organisms living at the same place. Several samples of small fish were also taken from the discharge channel. One meal per day of the most radioactive of these (bluegill) would contribute about 1% of the permissible daily ingestion of these four nuclides. (auth)

45537 DATA. SECTION II. WATER. Radiat. Data Rep.; 13: No. 6, 360-6(Jun 1972).

Data are presented on the gross radioactivity in surface waters sampled at 25 locations in the U.S. during Oct. 1971; ^{90}Sr content of surface waters sampled at 5 locations in the U.S. during Jan. to Apr. 1971; monthly gross beta radioactivity and radioisotope content of California water supplies sampled during 1970; and the gross radioactivity of California sewage samples measured during the same year. (L.C.L.)

Ecosystems and Food Cycles

Refer also to abstracts: 45478, 45762, 45808, 45903, 45909, 45914, 45919, and 45926.

45538 (HASL–257, pp I,51-70) ^{90}Sr IN HUMAN BONE: 1971 RESULTS FOR NEW YORK CITY AND SAN FRANCISCO. Bennett, B. G. 1 Jul 1972.

In Fallout program.

Results are presented of determinations of ^{90}Sr content of 254 specimens of human vertebrae obtained during 1971 in New York City and San Francisco. The average ^{90}Sr to Ca ratios for adult vertebrae, 0.80 pCi/g Ca in San Francisco and 1.40 pCi/g Ca in New York represent 7 to 10% decreases from average values of the previous year. Average ^{90}Sr concentrations in children's bones were somewhat higher than the adult values. An improved bone model has been formulated to describe the variations in ^{90}Sr content of bone and provide correlation with dietary ^{90}Sr intake. The two compartment model accounts for both short and long term retention of ^{90}Sr in bone. Regression analysis of the 11 years of survey data provides values of the relative retention of dietary ^{90}Sr and the effective bone turnover rate. These parameters of the bone model are constant for adults but age dependent for children. The bone model gives satisfactory description of observed bone ^{90}Sr levels and allows reliable assessment of the long-term behavior of ^{90}Sr in man. (auth)

45539 (HASL–257, pp II,1-6) HASL FALLOUT PROGRAM DATA. 1 Jul 1972.

In Fallout program.

The results of measurements of the ^{90}Sr content of foods purchased in New York City and San Francisco in the first quarter of 1972 are given. Estimates of the daily intake of ^{90}Sr based on these measurements and on the revised consumption statistics given in most recently available U. S. Dept. of Agriculture Report (U.S.D.A. ARS62-16) are also listed. (P.C.H.)

45540 (HASL–257, pp III,45-52) ^{137}Cs IN VARIOUS CHICAGO FOODS. (Collection Months, January and April 1972). Brar, S. S. (Argonne National Lab., Ill.). 1 Jul 1972.

In Fallout program.

Since April 1961, the ^{137}Cs and potassium content of the Chicago portion of Tri-City Diet Sampling Program has been determined in bulk food samples by gamma spectrometry using a 4″ × 4″ NaI (Tl) crystal. The individual food components were counted for a minimum of 100 minutes, and from these measurements composite daily and yearly food intakes were obtained. Cesium-137 activity in food, now, is an order of magnitude lower than it was a few years ago; consequently, a new procedure for these measurements has been adopted in order to improve accuracy. The same variety of foods (all fresh vegetables, all fresh fruits, etc.) are composited before measurement, and the samples are counted a minimum of 400 minutes. The results for the January and April 1972 quarters are tabulated. (auth)

45541 (NYO–2174-130) PLUTONIUM IN NORTH ATLANTIC OCEAN ORGANISMS; ECOLOGICAL RELATIONSHIPS. Noshkin, Victor E.; Bowen, Vaughan T.; Wong, Kai M.; Burke, John C. (Woods Hole Oceanographic Institution, Mass.). 1971. 19p. (CONF-710501–55). Dep. NTIS.

From third national symposium on radioecology; Oak Ridge, Tenn. (10 May 1971).

A considerable series of north Atlantic Ocean organisms were analyzed, by radiochemistry and alpha spectrometry, for fallout plutonium-238, -239, and -240. Organisms from the near-shore environment were selected to show the effects, on plutonium uptake, of variations in feeding habits, association with sediment or with absorptive surfaces, and of trophic level. In general plutonium concentrations are higher in organisms feeding on sediment or on surfaces than in those drawing largely on the water itself. There is some evidence that plutonium concentrations are higher in organisms of higher trophic levels. (auth)

45542 (PNE–529) ECOLOGICAL AND ENVIRONMENTAL EFFECTS FROM LOCAL FALLOUT FROM SCHOONER. 2. THE BETA AND GAMMA RADIATION EFFECTS FROM CLOSE-IN FALLOUT. Rhoads, William A.; Kantz, Asher D.; Ragsdale, H. L. (EG and G, Inc., Goleta, Calif.). 30 Jun 1972. Contract AT(29-1)-1183. 67p. Dep. NTIS.

Project Schooner, a nuclear cratering event with approximately eight to ten times the yield of two previous Nevada Test Site cratering events, Palanquin and Cabriolet, offered the opportunity to further investigate radiation doses and short-term effects to vegetation and the environment, where a larger affected area was anticipated and where topography might be expected to further influence the results of close-in fallout. Specially constructed dosimeters were placed at 92 locations, forming an arc with a radius of approximately 1.7 to 2.0 km, beginning about 12° west of north with respect to GZ. This arc was about 3.35 km long with a mean distance between dosimeter stations of 36 m. Dosimeters were positioned in vertical arrays at 25 cm, 1 m, and 3 m above the surface away from shrubs, as well as on the soil surface, and on shrubs. To determine whether preventing direct fallout from reaching the shrubs would protect them, polyethylene sheets were placed over shrubs at alternate stations. Twelve days after detonation the dosimeters were removed from the field and the protective sheets were removed. No effects were observed on the vegetation except a dusty covering on the unprotected shrubs. In April (D plus 4 months) the first effects attributable to radiation were noted. During the following months at the center of the fallout

pattern all Artemisia shrubs lost their leaves and died except those which had been covered with plastic sheets. Elsewhere along the arc there was a "skirting effect" in which the lower parts of larger shrubs were defoliated while the tops remained near normal. Small shrubs were completely killed. Increasingly larger shrubs were killed with higher doses. Beyond the dosimetry arc, a helicopter survey allowed an assessment of the extent of vegetation damage. South of the crater, study sites were established in the most diverse environments resulting from the crater formation. Vegetation analysis at these sites showed successional changes which might be expected to return the area to conditions approximating undisturbed conditions. (auth)

45543 (RLO-2225-T-1-9) DECLINE OF ^{65}Zn IN MARINE MUSSELS FOLLOWING THE SHUTDOWN OF HANFORD REACTORS. Seymour, Allyn H.; Nelson, Victor A. (Washington Univ., Seattle. Lab. of Radiation Ecology). 1972. Contract AT(45-1)-2225. 15p. (SM-158/16; CONF-720708-3). Dep. NTIS.

From Symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, WA. (10 Jul 1972).

The shutdown of the last of the eight original plutonium production reactors at the Hanford Atomic Plant in February 1971 eliminated the source of practically all of the radionuclides in the Columbia River and in the plume of Columbia River water in the Pacific Ocean. Zinc-65, perhaps the most biologically important of the Hanford-produced radionuclides in the marine environment, continues to be present in both the biota and the water fifteen months after shutdown. The amounts of ^{65}Zn in mussels at the mouth of the Columbia River and along the Washington Coast have been monitored since 1961, and data from these observations have been used as reference values to measure the loss of ^{65}Zn related to the shutdown of the reactors. The amount of ^{65}Zn in the soft tissues of Mytilus edulis from the North Jetty at the mouth of the Columbia River declined from 40 pCi/g of dry tissue in February 1971, to 6 pCi/g, dry, in May 1972. The effective half-life for ^{65}Zn was calculated to be 130 days and the loss of ^{65}Zn by processes other than physical decay, in terms of half-life, was calculated to be 277 days. The latter value is called ecological half-life rather than biological half-life, since there is some uptake of recycled ^{65}Zn but at a rate less than the rate of loss of ^{65}Zn by biological processes. At North Head, 5 km north of the Columbia River, the amounts of ^{65}Zn and Zn in M. californianus and the rate of decline was less than comparable values for North Jetty mussels, although the specific activity values, μCi ^{65}Zn/g Zn, for mussels from both locations, collected on the same day, were similar. The ^{65}Zn effective half-life value for North Head mussels was 149 days. The amount of ^{65}Zn in mussels from seven locations on the Washington Coast and in the Strait of Juan de Fuca, to a distance of 340 km from the Columbia River, declined in a regular manner in respect both to distance from the Columbia River and to time after reactor shutdown. (auth)

45544 (RLO-2225-T-14-4) NATURAL ^{210}Pb AND ^{210}Po IN A MARINE ENVIRONMENT. Schell, W. R.; Jokela, T.; Eagle, R. (Washington Univ., Seattle. Lab. of Radiation Ecology). 1971. Contract AT(45-1)-2225. 29p. (SM-158/47; CONF-720708-2). Dep. NTIS.

From Symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, WA. (10 Jul 1972).

A regional sampling program was initiated to determine the existing levels of ^{210}Pb and ^{210}Po in sediment, organisms, and water from different depths in a salt water sound and a fresh water lake. The collections were made with plankton nets, midwater trawls, sediment corers, and a large volume water sampler consisting of 0.3 μ Millipore filters and Al_2O_3 sorption beds (200 to 2,000 liters). The efficiency of collecting lead from fresh and salt water by the Al_2O_3 beds was determined. The sample analysis was made using ^{208}Po tracer for yield determination and low background alpha spectroscopy which separates the energies of ^{208}Po from ^{210}Po; the ingrowth and decay of ^{210}Po were used to determine ^{210}Pb. Computer programs were completed for data analysis, sorting, and retrieval. One interpretation of the early results of sample analysis from the fresh water and salt water environments was that the processes of erosion and leaching can contribute significantly to the concentration of ^{210}Pb and ^{210}Po in the aquatic environment. Regional differences were found which depend on the geological strata. Both the erosion process and the atmospheric fallout process must be considered as sources of these radionuclides in the aquatic environment. An unusually large concentration of ^{210}Po was found in the liver of a sablefish, Anoplopoma fimbria; the zooplankton in the same region also had a high ^{210}Po concentration. The nektonic crustacea have the highest ^{210}Po/^{210}Pb ratio of the organisms collected at ca 100. (auth)

45545 (UCRL-73744) ACCUMULATION AND LOSS OF COBALT AND CESIUM BY THE MARINE CLAM, MYA ARENARIA, UNDER LABORATORY AND FIELD CONDITIONS. Harrison, F. L. (California Univ., Livermore. Lawrence Livermore Lab.). 6 Jul 1972. 35p. (CONF-720708-7). Dep. NTIS.

From Symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, WA. (10 Jul 1972).

The accumulation of ^{60}Co and ^{137}Cs by clams was followed in the laboratory in aquarium systems in which the levels of radioactive and stable cesium and cobalt were held constant. At 3- to 21-day intervals during the 6-month accumulation period, groups of 8 animals were removed from the water and their soft tissues were dissected into 7 different organs and tissues. The concentrations of both ^{60}Co and ^{137}Cs in the edible tissues increased rapidly and then leveled off at concentrations of ^{60}Co that were about 200 times that of the water and of ^{137}Cs that were about 5 times that of the water. Variations in concentration among the body parts were larger for ^{60}Co than for ^{137}Cs. The effects of stable element concentration in water on the accumulation rates were assessed in groups of animals maintained in seawater containing 0.5, 2.5, and 12.5 μg/litre each of stable cobalt and cesium. Little regulation of cesium accumulation was observed at these concentrations; the rates of accumulation increased with the concentration in water. Some regulation of cobalt occurred at the higher concentrations. The accumulation of ^{60}Co and ^{137}Cs was followed also in clams introduced into a discharge canal receiving radioactive waste from a boiling-water reactor. Groups of 6 animals were sampled at 3-week intervals and concentrations were measured in the pooled, total soft tissues. Results obtained in the field will be compared to those obtained in the laboratory. Loss of ^{60}Co and ^{137}Cs was followed in animals that had accumulated a radioactive burden in the laboratory and then were transferred to unfiltered oceanic water at a marine station. Loss of ^{60}Co by the whole clam was monophasic, that of ^{137}Cs was biphasic. The kinetics of accumulation and loss were described by exponential equations. The rate constants of accumulation and loss and the steady-state concentration factors are being used in models to predict the dose to man from the consumption of animals exposed to radioactive releases. (auth)

45546 ARTIFICIAL RADIOACTIVITY OF FALLOUT AND FOOD IN THE NORTHERN DISTRICTS OF GDR IN THE YEAR 1969. Schulze, H.-A.; Randow, F. (Univ., Rostock, Ger.). Z. Gesam. Hyg. Ihre Grenzgeb.; 17: 255-7(Apr 1971). (In German).

The radioactive nuclides ^{90}Sr and ^{137}Cs that occurred in 1969 in milk and cereals in the three northern counties of the GDR (Mecklenburg) and in oversea imports were measured. Apart from the nuclides, the total-β-activity was determined in the fallout. The annual amounts of fallout radioactivity were 26.12 nCi β/m^2, 0.46 nCi ^{90}Sr/m^2, and 1.18 nCi ^{137}Cs/m^2 in Rostock and were, with the exception of the total-β-activity which remained unchanged, below the values of last year with 54 percent and 76 percent, respectively. The contamination of milk amounted to 5 pCi ^{90}Sr/l and 15 pCi ^{137}Cs/l, and that of cereals to 22 pCi ^{90}Sr/kg and 38 pCi ^{137}Cs/kg. Citrus and other tropical fruit contained 4 to 52 pCi ^{90}Sr/kg and 1 to 17 pCi ^{137}Cs/kg. Tea contained 600 to 4,400 pCi ^{90}Sr/kg and 500 to 800 pCi ^{137}Cs/kg, whereas the values for coffee were 32 pCi ^{90}Sr/kg and 105 pCi ^{137}Cs/kg. (auth)

45547 METHOD OF EVALUATING CHEMICAL POLLUTION LEVELS IN AQUATIC MEDIA AND FOOD CHAINS. Bittel, R.; Lacourly, G. (CEN, Fontenay-aux-Roses, France). Rev. Int. Oceanogr. Med.; 22: 129-41(1971). (In French).

The transfer of radioactive pollution in aquatic food chains can be evaluated using a simple mathematical model: $D = \Sigma D(Q,F,x)$ in which D = radiation dose delivered to the organism, Q = ingested quantity of each alimentary carrier, F = transfer factor from the environment to the organism, and X = environmental pollution level. The summation was carried out for the various foods and radionuclides considered. Compliance with the protection standards for man requires $D < = D_l$ (D_l = dose limit). This investigation demonstrates the feasibility of setting up a very simple model for the transfer of chemical pollution in marine food chains. This model simplifies the transfer parameter inventory, and enables the following parameters to be defined: acceptable daily dose; level limit for water; and critical food consumption. Indications are given of future research projects together with their priorities. (France)

45548 CONTENT OF CESIUM IN MUSCLES OF BROILERS, HENS, AND PARTRIDGES. Szulc, M.; Bruniak, A. (Warsaw Agricultural Univ.). Med. Wet. (Poland); 27: 297-9(1971). (In Polish).

The activity of cesium-137 in muscles of broilers, hens from individual farms, and partridges has been measured. Materials

were gathered from the Warsaw area in the autumn and winter season 1968 to 69. The measurement of radioactivity of ^{137}Cs was performed with gamma spectrophotometry by means of scintillation probe equipped with a NaI crystal and a single channel analyzer of impulse amplitude. The findings were expressed in activity units of ^{137}Cs in ash and muscles of birds examined, i.e., pCi/kg of ash and pCi/kg of fresh muscle. They showed that the muscles of broilers contained the highest content of ^{137}Cs (157.7 pCi/kg of muscle and 13.478 pCi/kg of ash); lower contents were found in muscles of hens (155.3 pCi/kg of muscle and 12.626 pCi/kg of ash), and the lowest in muscles of partridges (143.0 pCi/kg of muscle and 10.362 pCi/kg of ash). In addition, it was revealed that the content of ^{137}Cs in muscles of birds was lower than those in mammals. (NSA of Poland)

45549 PASSAGE OF ^{90}Sr FROM BOVINE BONES TO RECEIVED FOOD PRODUCTS. Szulc, M.; Mierzewska, H. (Warsaw Agricultural Univ.). Med. Wet. (Poland); 27: 346-9 (1971). (In Polish).

The basic purpose of the investigations performed in 1967 to 69 was to establish if raw bone material contaminated with radioactive strontium may be used in good processing. The investigations were carried out with bovine cervical vertebra and shoulders derived from normal animal carcasses. Basic technological processes commonly used in the processing of alimentary bones, e.g., boiling in tap water-equivalent of broth production, boiling in acidified water-equivalent of acidified soup production, bone dressing in the course of gelatin proanalysis (method of F. Bryant, A. Morgan, and G. Spicer), and then on the basis of measurement of radioactivity by the use of anticoincidental system were examined. It was found that in the examined processes of bovine bone dressing, supravital contaminated with ^{90}Sr, an average of 11.9%, 14.3% of ^{90}Sr were found in brews, and about 0.0006% in gelatin. The results obtained indicated that bovine bones heavily contaminated with ^{90}Sr cannot be used either for broth or for production of acidified soups; but it seems that they can be used as a raw material for gelatine production. (NSA of Poland)

45550 ACCUMULATION OF ^{90}Sr IN WHEAT ON SOD-PODZOLIC SOILS. Gulyakin, I. V.; Yudintseva, E. V.; Makarovich, K. I. Agrokhimiya; No. 4, 84-92(1971). (In Russian).

Thirty-two sod-podzolic soils were investigated. A close relation was observed between the ^{90}Sr accumulation in wheat and the quantity of exchangeable Ca in the soil, degree of the soil radionuclide stability, and the ^{90}Sr content in the plants at early developmental stages. The soil Ca/Sr relation was altered by the soil acidity and the amount of humus. (Euratom)

45551 ACCUMULATION AND DISTRIBUTION OF RADIOACTIVE ELEMENTS IN NATURAL PHYTOCOENOSES OF THE CARPATHIANS. Shevchuk, A. I. (Inst. of Botany, Kiev). Ukr. Bot. Zh.; 25: No. 4, 18-24(1968). (In Ukrainian).

A study was made during 1962 to 1965 on the accumulation and distribution of radioactive isotopes in the natural plant associations of the forest, subalpine, and alpine belts of the Carpathians. The accumulation of β-emitters per unit area was determined in associations dominated by the European spruce forest, Siberian juniper forest, Sesleria bielzii grass community, and Festuca rubra grass community. The data obtained were correlated with the amount of radioactive fallout during the years in question. The maximum amount of fallout was in 1963, followed by significant successive decreases in 1964 and 1965. The changes in the content of ^{90}Sr in herbaceous associations corresponded to variations in the ^{90}Sr fallout from year to year during the period in question. In arboreal and shrub associations there was a cumulative increase in the content of ^{90}Sr because of retention of this isotope from the fallout of earlier years by perennial organs of the plants. From Sept. 1962 to Sept. 1963 and Sept. 1963 to Sept. 1964 the spruce forest accumulated 55.8 and 60.8% of ^{90}Sr, respectively, that fell on its surface from the atmosphere and the Siberian juniper association (29.8 and 30.2%, respectively). Coniferous tree and shrub associations, by binding a considerable part of the ^{90}Sr and preventing it from subsequent migration, play an important sanitary role at present. In herbaceous associations, the principal amount of radioactive elements from aerial parts of plants is removed by animals during grazing. (Euratom)

45552 DATA, SECTION I. MILK AND FOOD. Radiat. Data Rep.; 13: No. 6, 347-59(Jun 1972).

The monthly averages and 12-month averages of ^{137}Cs and ^{90}Sr content in milk samples collected during Feb. 1972 and during Mar. 1971 to Mar. 1972 at 61 U.S. sampling stations, at 16 Canadian sampling stations, and at 7 sampling stations in Central and South America are tabulated. ^{140}Ba and ^{89}Sr were detected in only 4 samples from U.S. stations and are noted. (L.C.L.)

45553 RADIOECOLOGY OF Ce-^{144}Pr IN A LITTORAL FRESH-WATER MICROCOSM. Trabalka, John Richard. Ann Arbor, Mich.; Univ. of Michigan (1971). 225p. University Microfilms Order No. 72-15,021.

Thesis.

Results are reported from a study conducted over a period of 760 days in which natural conditions were simulated in two 5000 liter tanks which contained replicate microecosystems. Starting on day 493, the water in one tank was maintained at a mean concentration of 1.2×10^{-4} microcuries/cc of cerium-144 + praseodymium-144 until day 557. Throughout the study period the biological communities, consisting of over 200 species, were studied comparatively in the two tanks. Populations of the fathead minnow (Pimephales promelas) completed two life-cycles before day 341. The fish spawned three times between days 341 and 598; a total of 6464 larvae was examined microscopically for abnormalities. The dose to the fish gonads was estimated to be 16.5 rads, and to the fish embryos, 78 millirads in the treated tank. No statistically significant differences between the treated and control tanks were observed either in the frequency of abnormalities in fish larvae, or in the biological communities. At the end of the experiment, over 99% of the added radioactivity was in the sediment and 0.1% was in the water. (Diss. Abstr. Int., B)

45554 ASSESSMENT AND CONTROL OF ENVIRONMENTAL CONTAMINATION: EXPERIENCE WITH ARTIFICIAL RADIOACTIVITY. Butler, G. C. (National Research Council, Ottawa); Karol, I. L.; Lindell, B. G.; Stevens, D. J.; Zeleny, V. Biol. Conserv.; 4: No. 3, 177-84(Apr 1972).

The basic principles followed in assessing and controlling radioactive contamination of the environment are outlined. These principles largely stem from the nature of the relationship between dose and effects of radiation. Acute effects only occur at doses and dose-rates much higher than those likely to arise from environmental contamination, except in major accidents. For delayed effects, both genetic and somatic, it is assumed that the increment in biological effect per unit increment in dose is the same at all doses, i.e., there is a linear non-threshold dose relation, and the biological effect of a given dose is independent of the rate at which the dose is delivered. These assumptions are conservative since they imply that no doses are "safe" in absolute terms but that all doses involve a risk proportional to their magnitude, and that relying on them will, in most practical cases, result in overestimates of the risk of harm at low doses and low dose-rates. The assumptions justify the use of the concepts of "dose-commitment" — the total average dose to be received by the members of a population, living and to be born, as a result of a release of radioactivity in the environment — and of "harm commitment" (a measure of the total harm expected in that population as a consequence of the dose commitment received). The application of these concepts to the establishment of norms for the protection of the public and of surveillance programmes is discussed. (auth)

45555 CONVENTIONAL AND RADIOACTIVE POLLUTION IN THE ENVIRONMENT. Cigna, Arrigo A. (CNEN, Milan). Com. Naz. Energ. Nucl., Notiz.; 18: No. 5, 25-7(May 1972). (In Italian).

A comparison is made between risks of various kinds in the development of nuclear energy, the levels allowed for peaceful uses, and the natural and artificial types of radiation. A typical exposure for the population of the U.S. is discussed, involving the natural background, diagnostic x rays, fallout from nuclear explosions, color TV sets, luminous dials, and employment in nuclear plants. Risks vs benefits are evaluated, and maximum permissible limits are defined. Causes and probability of death or serious injury resulting from non-radiation causes (auto accidents, drowning, cancer, etc.) are examined. (K.S.W.)

45556 REPORT OF COMMITTEE 4 ON PRINCIPLES OF ENVIRONMENTAL MONITORING RELATED TO THE HANDLING OF RADIOACTIVE MATERIALS. CIPR-7. Fontenay-aux-Roses, France; Centre d'Etudes Nucleaires ([1971]). 26p. (In French).

Translation of Report of Committee 4 on Principles of Environmental Monitoring Related to the Handling of Radioactive Materials, Oxford, Pergamon Press.

Environmental monitoring is the term applied to radiation and radioactivity measurements made outside the limits of installations using radioactive substances or sources. One of the principal objectives of the environmental monitoring program is the evaluation of the real or potential exposure of man to radioactive substance or radiations present in the environment, and the determination of the maximum probable limits of such an exposure. The objectives and the different factors intervening in the development of routine monitoring programs for the exterior of installations were studied. Preliminary studies concerned with the putting into service of these operations enabled information about nuclides, modes of transfer, critical groups reference man, and normal op-

eration to be obtained. Monitoring programs in the case of emergencies (accidental irradiation) are also studied. (France)

Radiometric Techniques

Refer also to abstracts: 45205, 45444, and 45658.

45557 REAPPRAISAL OF THE $^{40}Ar/^{39}Ar$ STEPWISE DEGASSING TECHNIQUE. Brereton, N. Robin (Cambridge Univ., Eng.). Geophys. J. Roy. Astron. Soc.; 27: No. 5, 449-78(May 1972).

The principal advantage of the $^{40}Ar/^{39}Ar$ dating method lies in the stepwise degassing technique. Despite the widespread use of the technique, each worker seems to adopt an individual criterion of choice, as to how the data should be treated, so as to extract the maximum amount of information from it. A detailed analysis of the data taken during a number of stepwise degassing experiments was made to decide upon the most useful treatment of results. The basic principles of the technique are reviewed, and a method of data analysis is presented, which enables a detailed study of the argon liberation characteristics of the sample to be made. It also allows the age of the sample to be determined, such that no direct correction is made for atmospheric contaminant ^{40}Ar. This avoids the fundamental assumption that all ^{36}Ar, used to make this correction, is of atmospheric origin. (auth)

45558 PRELIMINARY DATA ON THE TRITIUM CONTENT OF AQUIFER SHEETS IN NORTHWEST AND CENTRAL (ALGERIA) SAHARA; HYDROGEOLOGICAL CONSEQUENCES. Conrad, Georges (Rouen Univ., Mont-Saint-Aignan, France); Olive, Philippe. Compt. Rend., Ser. D; 274: No. 14, 2019-22(5 Apr 1972). (In French).

The interpretation of the tritium activities of the principal aquifer sheets was effected using isotopic data collected (since 1964) on precipitations and surface hydrology. The present day surface aquifer recharge linked to the hydrographic network appears at Saoura, the Chech erg and Ahnet–Mouydir. In contrast no rapid contributions of precipitations occurring after 1955 to the feeding of the economically important sheets of the septentrional Sahara has taken place. (France)

45559 WELL LOGGING METHOD FOR DETERMINING THE PRESENCE OF ALUMINUM AND MAGNESIUM. Youmans, Arthur H. (to Dresser Industries, Inc.). U. S. Patent 3,662,173. 9 May 1972. Filed 27 Oct 1969.

An activation well logging method for determining the presence and quantity of aluminum and magnesium in formations surrounding a borehole is described. The formations are irradiated with 14 MeV neutrons which produce aluminum and magnesium activity with half lives of 20 milliseconds and gamma ray energy of 473 keV. The neutron source is turned on for a period of time sufficient to activate aluminum and magnesium and then turned off for 20 milliseconds. During the first 4 milliseconds while the source is off, no measurement is made. During the remaining 16 milliseconds, pulses are counted which fall in the amplitude range representing gamma ray energies from 450 keV to 500 keV. The rate of occurrence of these pulses is an indication of the aluminum and magnesium content of the formation. To correct for undesired background, the rate of occurrence of pulses in the energy intervals immediately above and below the 450 to 500 keV interval is determined and subtracted from the 450 to 500 keV measurement. (Official Gazette)

45560 DEVELOPMENTS IN GEOPHYSICAL LOGGING INSTRUMENTS AND METHODS. Andrassy, L.; Barat, I.; Liszt, Ferenc; (and others). Magy. Allami Eotvos Lorand Geofiz. Int. Evi Jelentese; 1969: 89-93(1970). (In Hungarian).

More than half the effort of the well logging group of the Geophysical Institute in Hungary in 1962 was devoted to instrumental development. Radioactive logging equipment with gas-discharge and semiconductor detectors was constructed. The surface pulse-processing and control unit, two linear ratemeters, a pulse-separating calibrating generator, a universal stabilized supply unit, and a mass voltage converter have been finished. Scintillation radioactive equipment was further improved. Precision circuits have been designed for better signal transmission in energy-selective borehole instruments. The circuit design of spectrum-frequency logging equipment was given its final shape. Acoustic logging equipment was used in practical measurements in velocity logging, cement-bond logging, and porosity determinations. Work continued on the development of calibrating equipment for radioactive logging apparatus. Activation analysis with a neutron generator is now routine in the laboratory, particularly with an automatic bauxite analyzer designed and built in the Geophysical Institute. Digital well logging apparatus is being developed in cooperation with other institutions. (Geophys. Abstr.)

45561 THERMAL NEUTRON ACTIVATION RADIOACTIVITY LOGGING METHOD. Youmans, Arthur H. (to Dresser Industries, Inc.). U. S. Patent 3,665,195. 23 May 1972. Filed 16 Oct 1969.

A method is described for determining the existence and quantity of an element in a formation. A portion of the formation is irradiated with neutrons and the gamma rays emanating from the formation due to induced radioactivity, or activation from thermal neutron capture by the element of interest are detected and recorded. The thermal neutron capture cross section of the formation is determined. The product of the gamma ray emission and the thermal neutron capture cross section is obtained as a quantitative indication of the element's abundance in the formation. (Official Gazette)

45562 RADIOACTIVITY WELL LOGGING SYSTEM HAVING A PAD MOUNTED NEUTRON SOURCE AND A CENTRALIZED RADIATION DETECTOR THAT PROVIDES COMPENSATION FOR BOREHOLE FLUID DENSITY AND BOREHOLE DIAMETER VARIATIONS. Youmans, Arthur H. (to Dresser Industries, Inc.). U. S. Patent 3,662,172. 9 May 1972. Filed 24 Oct 1969.

A well logging instrument adapted for traversing an earth borehole has a plurality of neutron sources mounted in pads which contact the wall of the earth borehole. The radiation detector is centralized in the borehole and the system provides compensation for natural gamma radiation and variations in borehole fluid density and borehole diameter. (Official Gazette)

45563 PULSE NEUTRON LOGGING TOOL CONTROL AND TRANSMISSION SYSTEM. Frentrop, Arthur H.; Wahl, John S. (to Schlumberger Tech. Corp.). U. S. Patent 3,662,179 9 May 1972. Filed 25 Apr 1969.

An illustrative embodiment of the invention measures the thermal neutron decay time in earth formations traversed by a borehole. For example, with a latching relay downhole, only one electrical conductor and a ground return is needed to send power and neutron generator control signals to the logging tool. The repetition rate and the duration of the neutron bursts, as well as the decay time measurements, all are regulated automatically through downhole circuits in response to the neutron characteristics of the formation under study. The single conductor and ground return also transmit the decay time measurements to the earth's surface. A gate enabling relay downhole also responds to direct current signals and selects detector count information for transmission to the surface through a manipulation of the thermal neutron decay time information signal polarity. Other information signals, of which casing collar locator signals are typical, also can be transmitted through the conductor. (Official Gazette)

45564 APPLICATION OF WELL LOGGING METHODS IN HYDROCARBON PROSPECTING, DRILLING, AND PRODUCTION TO THE STUDY OF GEOSTATIC PRESSURE PROBLEMS. Fertl, W. H.; Timko, D. J. (Continental Oil Co., Ponca City, Okla.). Rev. Inst. Fr. Petrole Ann. Combust. Liquides; 26: No. 9, 687-714(Sep 1971). (In French).

A number of well logging methods are being used by the oil industry to detect and evaluate overpressure formations. Worldwide experience in exploring for oil and gas indicates a significant correlation between the presence and magnitude of geopressures and the log-derived shale-sand ratio of sedimentary sections penetrated by the drill bit. Knowledge of the expected pore pressure and fracture gradient is the basis for making the best of modern drilling techniques. This prevents a breakdown of exposed formations and contains the high-pressure fluids in deeper intervals, thereby reducing blowout hazards. In several sedimentary basins throughout the world, the magnitude of log-derived in situ rock parameters, such as pore-fluid pressures derived from conventional well logs, correlates very well with the distribution and type of hydrocarbon accumulations. Pulsed neutron logging devices can be applied to monitor pore pressure variations behind casing. (France)

45565 RADIOACTIVITY OF WASTE WATERS IN NUCLEAR RESEARCH INSTITUTE, REZ, AND ENVIRONMENT. Krepelka, Jiri (Nuclear Research Inst., Rez, Czech.); Chysky, Jaromir. Jad. Energ.; 18: No. 5, 146-50(May 1972). (In Czech).

A system of drainage of liquid wastes and a method of liquidation of radioactive wastes in the Nuclear Research Institute are briefly described. The radioactivity of waste waters discharged into the river is controlled discontinuously. The gross beta-gamma activity is determined in samples. The control also includes a continuous measurement of the activity of chemical wastes discharged separately. Both methods are adequate in view of the isotopes that might be present in a given mixture. In the period of 1963 to 1971, more than 2000 samples were measured. The values obtained

were very low, which shows a good function of the liquidation station. No effect on the activity of the river Vltava, into which the wastes were discharged, was found. Therefore, a measurable increase in the exposition by ionizing radiation could not occur in the inhabitants using the Vltava water. The continuous measurement showed several times an accidental uncontrolled discharge of the activity into the chemical drainage and into the river. However, it was found that the maximum permissible concentrations for drinking water could not be exceeded in the river Vltava, which was also proved. The results showed that the amount of activity treated and the qualitative isotopic composition need be known for a complex hygienic evaluation of the system of liquidation of wastes in larger nuclear plants. (auth)

45566 DETERMINATION OF DENSITY AND EFFECTIVE ATOMIC NUMBER OF ROCKS AND ORES BY GAMMA–GAMMA METHOD IN THE PRESENCE OF AN INTERMEDIATE ZONE. **Artsybashev, V. A.; Ivanyukovich, G. A.** (Leningrad Mining Inst.). Izv. Vyssh. Ucheb. Zaved., Geol. Razved.; No. 9, 97-101 (Sep 1971). (In Russian).

The density and effective atomic number of rocks and ores were determined by the gamma-gamma method in the presence of the so-called "intermediate zone", formed because of irregularities in the aperture walls, of caverns, crusts, etc. Certain conditions were observed in the measurements: constant geometry and constancy in the source and the detector. However the gamma field depended on the gamma quantum properties of the medium and the intermediate zone: $N = F(\rho, Z_{eff}, h)$, where N is the measured gamma field characteristics, ρ is the density of the medium, Z_{eff} is the effective atomic number, and h is the level of the intermediate zone—the distance from the zone surface to the bore wall. Two variants of the solution to the problem are explained for simultaneous determination of ρ, Z_{eff}, and h. The results of experimental testing on a bore-hole model are interpreted. A 2π probe with a ^{60}Co source and scintillation detector were employed. The body of the probe was made of Al and had a thickness of 3 mm. No supplementary filtration of the gamma radiation was supplied. The initial threshold of the recording of the gamma quanta was 20 to 30 keV. The integral beam of scattered gamma radiation was recorded. (tr-auth)

45567 APPLICATION OF NEUTRON ACTIVATION TO THE DETERMINATION OF ELEMENTS IN BOREHOLES. **Wichmann, P. A.** Rev. Inst. Fr. Petrole Ann. Combust. Liquides; 26: No. 9, 715-29(Sep 1971). (In French).

Some of the neutron activation logging methods which have been used over the past few years are reviewed. These methods depend almost entirely on the half-lives and radiation intensity of the activation products. The elements which are most conveniently identified in this manner include oxygen, silicon, and aluminum. Field examples of the logs and/or measurements involved in each of these determinations are given. The application and relative value of each of these determinations, the discussion of limitations of the presently available field techniques, and possible solutions of the limiting problems are discussed. The most likely solution of these problems is primarily related to the use of gamma spectral measurements to define the activation products. Field examples of test data supporting the validity of these solutions are also presented. The method is shown to be a viable approach for determining lithologic components (through elemental assay) in well bores containing a wide range of conditions. While having certain limitations, the techniques described have the almost singular advantage of being direct measurements of the elemental constituents under investigation. (France)

45568 ISOTOPE RATIO TRACER METHOD: APPLICATIONS IN ATMOSPHERIC SULFUR POLLUTION STUDIES. **Manowitz, Bernard; Smith, Maynard E.; Steinberg, Meyer; Newman, Leonard; Tucker, Walter D.** (Brookhaven National Lab., Upton, N. Y.). pp 993-9 of Proceedings of the Second International Clean Air Congress. /Englund, H. M. (ed.). New York; Academic Press, Inc. (1971).

From second international clean air congress conference; Washington, D. C. (6 Dec 1970). See CONF-701229.

The isotope ratio tracer method (IRT) is based on the natural variation in the ratios of the stable isotopes in sulfur coming from different sources. It is possible with the IRT method to measure changes in the ratio of ^{32}S to ^{34}S that may result from isotope exchange following chemical reaction with sufficient precision to indicate the degree of conversion that has occurred. The use of the sulfur hexafluoride tracer system in conjunction with IRT greatly increases its usefulness. (D.H.M.)

45569 AGE OF CUPROUS UDOKAN SERIES (OLEKMO–VITIM MOUNTAIN SYSTEM) BY URANIUM–LEAD METHOD. **Bogdanov, Yu. V.; Iskanderova, A. D.; Levskii, L. K.** Izv. Akad. Nauk SSSR, Ser. Geol.; No. 9, 29-34(Sep 1971). (In Russian).

The age estimation of the Udokan series (Olekmo-Vitim mountains) was conducted by means of the radiogenic lead occluded in the rock samples. In order to establish the time of accumulation of the Udokan sediment, the lead content and isotopic composition of six types of sandstones were determined. Both U and Th data were obtained on three of the samples. The isotopic composition of Pb was measured on the MI-1309 mass spectrometer by thermionic emission using a dry aluminum silicate emitter. The U in the sandstones was determined by radiochemical and luminescence methods. The Th was determined by radiochemical and colorimetric (Arsenazo III) methods. The age, from the U–Pb method, of the deposits of the Udokan series was confirmed by argon dating of granitoids—faulted rock of the Udokan series. They verified the correctness of the connection of the copper-bearing carbonate-terigenic strata of the Udokan series with the lower Paleozoic. (tr-auth)

Site Surveys

Refer also to abstract: 45510.

45570 (EUR-4841) SITE CHARACTERISTICS. **de Bortoli, M.; Gaglione, P.; Gandino, C.** (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 1972. 98p. (In Italian). Dep. NTIS (U. S. Sales Only). EUR FB 125,-.

The main features of the Ispra site concerning the meteorological, geologic, hydrologic demographic, and ecological aspects are described. The information was gathered partly from reports available at the Ispra Euratom JRC, partly from the Ufficio Provinciale di Statistica di Varese, and partly from inquiries performed directly by the Site Survey Meteorology Section of the Division Protection. (auth)

45571 (NVO-55) PROJECT WAGON WHEEL: PRELIMINARY SITE EVALUATION REPORT. (Nevada Operations Office (AEC), Las Vegas). Mar 1970. 31p. (PNE-WW-2). Dep. NTIS.

After reviewing currently available data and conducting preliminary on-site investigations, the proposed Wagon Wheel site, at this time, is recommended for further study and investigation as a possible location for a nuclear explosive gas stimulation experiment. In preparing the evaluations of the Wagon Wheel area, it was assumed that the experiment would utilize an explosive having a yield of 100 kt buried at a depth of at least 10,000 feet. It should be understood that when a definitive technical program has been agreed to by industry and government, some revisions to the following statements may be required. Several areas where further detailed studies will be required include: nearby large reservoir sites; mining operations within a 184 km radius; and abandoned coal mines at Rock Springs, Wyoming, 121 km south of Wagon Wheel. A factor which should be given early consideration is the season of the year most suitable for detonation, since each season has some particular limitation. In summer, there is considerable tourist activity. During the fall, the hunting season provides considerable income for this area. The winter season is accompanied by heavy snow and severe cold which might present operational difficulties, particularly if any evacuation was necessary. The spring and early summer seasons, because of melting snow and heavy run-off, have full reservoirs and lakes. Also, heavy ground saturation could increase the potential for triggering earth movement and ground motion. These conditions should be examined closely to determine which would be the least restrictive season for detonation. These statements do not attempt to cover the total program of detailed effects evaluations to be conducted during the project definition phase of the project, but they do reflect the types of efforts which will be involved in the detailed studies of the Wagon Wheel site. (auth)

45572 (WASH-1523) LEASING OF AEC CONTROLLED URANIUM BEARING LANDS, COLORADO, UTAH, NEW MEXICO. Environmental Statement. (Atomic Energy Commission, Washington, D. C.). Mar 1972. 130p. Dep. NTIS.

The USAEC proposes to lease certain AEC-controlled lands in the Colorado Plateau region for the production of uranium–vanadium ores. About 25,000 acres of land are available for leasing in about two dozen tracts, in western Colorado, eastern Utah, and northwestern New Mexico. The lands are located in long established mining districts and most were mined previously under AEC leases until 1962. The known reserves of U–V ores on these lands are substantial and the potential for further ore discovery is also good. The known reserves alone when produced and delivered to a mill have a market value on the order of $45 to 50 million. An appraisal of the AEC controlled lands was made to determine the potential adverse environmental effects of the proposed leasing program. A multi-disciplined team was used which included experts in various fields from the Bureau of Land Management of the Department of Interior, an AEC contractor,

Lucius Pitkin, Inc., the Forest Service, Department of Agriculture, and the AEC. Factors considered included: present multiple use practices including range and livestock, wildlife, and recreation; prehistoric and historic values; soil and watershed, forestry, roads, other mineral values; mining requirements for water and other resources; water, air, and other pollution possibilities from mining and milling operations; proposed land use projects; and potential effects on local communities, water, power supplies, schools and other facilities. As a result of this review, draft stipulations were developed, and will be included in lease agreements to minimize potential adverse effects of the conduct of exploration and mining activities on the AEC controlled lands. The alternatives to this plan are to not lease, and return lands to the public domain or to not lease, and maintain lands in withdrawn status. Considering the substantial anticipated benefits versus the rather minimal adverse environmental effects and dollar costs, and in view of the range of reasonable alternatives, it was determined that the proposed leasing program should be undertaken. (L.C.L.)

Thermal Effluents

Refer also to abstracts: 47397, 47401, 47404, 47413, 47424, 47435, 47437, 47446, 47448, 47465, 47471, 47473, 47479, 47486, 47487, 47489, 47497, 47498, 47502, 47510, 47516, 47532, 47534, 47535, 47539, 47543, 47545, and 47564.

45573 (AE-448) LOW-GRADE HEAT FROM THERMAL ELECTRICITY PRODUCTION: QUANTITY, WORTH, AND POSSIBLE UTILISATION IN SWEDEN. Christensen, Joergen (Aktiebolaget Atomenergi, Studsvik (Sweden)). 8 Oct 1971. 101p. Dep. NTIS (U. S. Sales Only).

In a thermal cycle working process, entropy is degraded from one temperature to a lower temperature, T_2. The loss of heat at T_2 is an inescapable part of the process; if the entropy flow is $\dot{S}$, the flow of this degradation heat is $\dot{S} \times T_2$. The ratio of heat flow to mechanical power or, in an electric generating plant, say, the cooling/electricity power ratio may be influenced in several ways, but radical changes can hardly be expected, not even with fusion power. Swedish degradation heat flow by 2000 A.D. is estimated to be 70 GW ± 14 GW. The pricing of heat from a combined plant is and must be arbitrary. A pricing method based on energy coupled to the electricity market is chosen here. Low-grade heat at temperatures above that of the cooling outlet from electricity-only plants is not cost free. Among the ways of utilizing low-grade heat considered are distillation of sewage, heating of soil, heating of greenhouses, heating of water for aquaculture, and chemical processes. (auth)

45574 (CONF-720619-1) MEASUREMENT OF LIQUID DROPLET EMISSIONS FROM COOLING TOWERS AND PROCESS STACKS. Fish, Birney R.; Duncan, Joseph R. (Tennessee Univ., Knoxville). 1971. 21p. Dep. NTIS.

From sixty-fifth meeting of the air-pollution control association; Miami Beach, FL. (18 Jun 1972).

Many air pollution control regulations specifically exclude from their definition of an air contaminant that which is termed "uncombined" water droplets. However, there is an increasing awareness that water drops from some sources contain various salts, fungicides, corrosion inhibitors, and other dissolved or entrained material. Measurement of the emission rate of water droplets requires special techniques similar to those that have been used in studying the microphysics of clouds and fog. A new method of water droplet size analysis was developed, combining the techniques of the impaction stain methods with standard filter paper air sampling. The air filter is sensitized by soaking it in an aqueous solution of potassium ferricyanide, drying it, and then dusting it with finely ground ferrous ammonium sulfate. These two compounds dissolve in a captured water droplet and react to form an insoluble blue dye which precipitates near the evaporating periphery of the droplet leaving a ring-like blue stain. Droplet diameter can be related to stain diameter by calibrating the sensitized paper using known size droplets. Field tests confirm the validity of the air filter-strain method in measuring the emission of droplets from a water cooling tower. (auth)

45575 PREDICTION OF HEATED EFFLUENT DISPERSION IN A STREAM USING SIMILITUDE TECHNIQUES. DeLong, Max Myron. Ames, Iowa; Iowa State Univ. (1972). 121p. University Microfilms Order No. 72-19,981.

Thesis.

An experimental study is done to develop prediction equations for heated effluent dispersion using open channel models designed by similitude techniques. In some models the flow depth is intentionally distorted compared to the horizontal dimension. The principles of engineering similitude are used to analyze open channel flow, and sixteen dimensionless ratios, or Pi terms, are developed to describe the phenomenon of heated effluent dispersion. Distortion factors are defined to characterize the intentional and unavoidable deviations of the model design conditions from those of a true model. Seven open channel systems were paired in different combinations to achieve models with different length scales and different degrees of depth distortion. Temperature data were obtained by using thermistors. Prediction factors were developed from the experimental data. The relation of prediction factor with depth and slope distortion factors and length scale was determined. (Diss. Abstr. Int., B)

45576 LIVESTOCK SHELTERS AS HORIZONTAL COOLING TOWERS. Hirst, Eric (Oak Ridge National Lab., Tenn.). Agr. Eng.; 53: No. 5, 18-19(May 1972).

A proposal is presented for using power plant waste heat for providing optimal thermal conditions for raising small farm animals such as chickens and pigs. The quantity of heat rejected from U. S. power plants, the heat requirements for raising broilers and pigs in various geographical locations, and shelter and ventilation requirements, and the advantages and problems associated with this use of power plant waste heat are discussed. (L.C.L.)

45577 PROCEEDINGS OF THE FOURTEENTH CONFERENCE ON GREAT LAKES RESEARCH, TORONTO, ONTARIO, APRIL 19-21, 1971. Ann Arbor, Mich.; International Association for Great Lakes Research (1971). 844p. (CONF-710431).

Seventy-five papers on Great Lakes research were presented at the conference. A separate abstract was prepared for each of 7 papers. One paper was previously abstracted for NSA. For an abstract of this see CONF-710431 in the Report Number Index. Sixty-seven papers were not within the scope of NSA. (L.C.L.)

For abstracts of individual papers see: 45535, 45536, and 45578-45582.

45578 INFLUENCES OF THERMAL EFFLUENTS UPON AQUATIC PRODUCTION IN LAKE ONTARIO. Fenlon, M. W.; McNaught, D. C.; Schroder, G. D. (State Univ. of New York, Albany). pp 21-6 of Proceedings of the Fourteenth Conference on Great Lakes Research. Ann Arbor, Mich.; International Association for Great Lakes Research (1971).

From fourteenth conference on Great Lakes research; Toronto, Ontario, Canada (19 Apr 1971). See CONF-710431.

Additions of heat to the Lake Ontario ecosystem at Nine Mile Point have increased the standing crop of Bosmina 25.0 times and Daphnia retrocurva 1.2 times in the overall study area. Adjacent to the outfall these same populations increased 123.8 and 2.4 times respectively. At the same time primary production was not significantly affected. It is suggested that turning-over these large populations of herbivores by fishing their predators may reduce the likelihood of algal blooms as thermal additions to the Great Lakes are increased in the 1980's. (auth)

45579 THERMAL PLUME DATA ACQUISITION, DOCUMENTATION, AND INITIAL ANALYSIS. Abu-Shumays, I. K.; Phillips, D. L.; Prastein, S. M. (Argonne National Lab., Ill.). pp 495-506 of Proceedings of the Fourteenth Conference on Great Lakes Research. Ann Arbor, Mich.; International Association for Great Lakes Research (1971).

From fourteenth conference on Great Lakes research; Toronto, Ontario, Canada (19 Apr 1971). See CONF-710431.

A brief description is presented of the temperature data acquisition and documentation procedure adopted by interdisciplinary group at Argonne National Laboratory during the summer of 1970. The 12 August, 1970 thermal plume at the Commonwealth Edison Waukegan Station is used to illustrate the procedure. The aim was to employ relatively simple and economic methods of acquiring and analyzing the data needed to explore thermal plume structure. The accuracy of the procedure is analyzed and an initial computer program for documenting the data and displaying plume patterns is described. The statistical nature of the thermal plume is stressed, and what might be called a statistical plume and an average or representative plume is discussed. (auth)

45580 NATURAL AND UNNATURAL WATER TEMPERATURES IN ZION-WAUKEGAN, ILLINOIS AREA OF SOUTHWEST LAKE MICHIGAN. Beer, Lawrence P. (Industrial BIO-TEST Labs., Inc., Northbrook, Ill.). pp 507-21 of Proceedings of the Fourteenth Conference on Great Lakes Research. Ann Arbor, Mich.; International Association for Great Lakes Research (1971).

From fourteenth conference on Great Lakes research; Toronto, Ontario, Canada (19 Apr 1971). See CONF-710431.

A well-defined thermal bar observed offshore from the Zion-Waukegan, Illinois area of southwest Lake Michigan on Apr. 23, 1970 moved offshore a distance of at least 6,080 m by Apr. 30 a velocity of movement of at least 0.01 m/sec. A poorly defined thermal bar was observed on Dec. 18, 1970. Ambient water tem-

peratures during the period of summer stratification varied considerably between two locations 6 to 8 mi apart. During the fall stratification was reduced and winter water temperatures were nearly isothermal in the near-shore waters. Thermal plumes from the Waukegan Generating Station (Waukegan, Illinois) varied in surface area from approximately 50 acres to approximately 174 acres during the five days of observation (during Apr. 23, 1970 to Feb. 16, 1971). Plumes were directed generally downwind, except in the case of onshore winds. Then, the plume assumed a pear shape east of the outfall and did not move upshore or downshore. Water temperatures at the lake bottom were affected by the plume from as little as 153 m to as great as 1,980 m from the outfall. The distance affected appeared to be a function of the depth of the lake in the downwind direction. The thermal plumes tended to rise to the surface and exchange heat with the atmosphere except when ambient winter waters were cold enough (<4°C) to allow the warmer, more dense plume water to sink to the bottom. In this case, however, mixing of plume water with ambient colder water apparently was rapid. (auth)

45581 THERMAL PLUME STUDY AT DOUGLAS POINT, LAKE HURON. Csanady, G. T.; Crawford, W. R.; Pade, B. (Univ. of Waterloo, Ont.). pp 522-34 of Proceedings of the Fourteenth Conference on Great Lakes Research. Ann Arbor, Mich.; International Association for Great Lakes Research (1971).

From fourteenth conference on Great Lakes research; Toronto, Ontario, Canada (19 Apr 1971). See CONF-710431.

The temperature structure was explored of the cooling water effluent plume of the Douglas Point nuclear generating station. Two thermistor probes were carried on a short sampling boom on a catamaran and the plume was criss-crossed many times to provide fairly detailed cross-sections of thermal structure. Current speeds were also measured, so that the heat flux at successive sections of the plume could be estimated, although only with moderate accuracy. The results may be presented in terms of a four component system: (1) the power station; (2) the "identifiable plume" defined as that body of water lying within the 0.5°C excess temperature isotherm; (3) the atmosphere; and (4) the remainder of Lake Huron. All the injected heat flows from (1) to (2), a fraction of it flows from (2) to (3), the remainder from (2) to (4) in the first instance, although it is ultimately transferred to (3), but over a rather larger area and at rather lower excess temperatures than the flux going directly from (2) to (3). The magnitude of this "direct" heat flux to the atmosphere (as a fraction of the total rejected heat) varied somewhat, and the estimate was also subject to considerable random scatter, but it seemed to be approximately ⅓. The "identifiable plume" was shallow and broad, its typical depth being 1.2 to 1.5 m, width 600 m and length 2300 m. The shallowness was somewhat remarkable: the densimetric Froude number based on this depth and current speed appears to be around unity. (auth)

45582 EXPERIMENTAL AND NUMERICAL INVESTIGATIONS OF RECTANGULAR JET. Paul, John; Prahl, Joseph (Case Western Reserve Univ., Cleveland). pp 607-17 of Proceedings of the Fourteenth Conference on Great Lakes Research. Ann Arbor, Mich.; International Association for Great Lakes Research (1971).

From fourteenth conference on Great Lakes research; Toronto, Ontario, Canada (19 Apr 1971). See CONF-710431.

Experimental and numerical results are presented for a rectangular constant temperature jet, horizontally entering a basin of constant depth equal to the vertical extent of the jet. The experimental investigation is carried out on a 6 ft × 20 ft (1.83 m × 6.10 m) water table. Velocity profiles were measured by a conventional hot film constant temperature anemometer. The numerical investigation is based upon a vertical integration of the three-dimensional, time-dependent Navier-Stokes equations for an incompressible fluid. The final equations solved are essentially two-dimensional volume flux equations with parameters in the inertial and bottom friction terms. Results, both experimental and numerical, indicate that the effect of bottom friction is to introduce a diffusive behavior to the jet. (auth)

45583 THERMAL POLLUTION: A POTENTIAL THREAT TO OUR AQUATIC ENVIRONMENT. John, James E. A. (Univ. of Maryland, College Park). Environ. Aff.; 1: No. 2, 287-98 (Jun 1971).

In the next decade and beyond, with the very large amount of thermal energy to be discharged into our rivers, lakes and streams, there is a very real danger of degrading our aquatic environment. Up to the present time, there have been some reported cases of fish kills due to heated water effluents, yet not a large number. Rather, what has been reported are subtle effects that have been observed by scientists. It is clear that, if the number of power plants on lakes and rivers is allowed to increase without control, these subtle effects can only multiply and increase in magnitude, producing irreversible effects on our environment. One of the key factors in the control of thermal pollution is the selection of a suitable site for a power plant. In the past, site selection has been based mainly on economic considerations. In the future site selection must also take into account the effect of the power plant on the ecology of the surrounding area. The engineer will have to work hand in hand with the biologist on both site selection and operation of the plant. In many locations, it may be necessary to incur the added cost of cooling towers or ponds to protect rivers, lakes and streams. It is clear that, in the long run, the ultimate goal, and one that seems within the reach of today's technology, should be to utilize the waste heat from a power plant for the benefit, rather than to the detriment, of man and his environment. (auth)

45584 ATMOSPHERIC EFFECTS OF THERMAL DISCHARGES INTO A LARGE LAKE. Carson, James E. (Argonne National Lab., Ill.). J. Air. Pollut. Contr. Ass.; 22: No. 7, 523-8(Jul 1972).

Concern for the biological and ecological effects of heated water has resulted in legal actions that will prevent power companies from dumping the waste heat from the majority of their new generating units into rivers and lakes. Many nuclear- and fossil-fueled plants now under construction, and even some now online, are being required to change from once-through cooling systems to other methods, such as wet cooling towers, cooling ponds, and spray canals, despite higher costs and lower thermal efficiencies. Yet, these alternate cooling procedures are not without their own environmental problems. The primary weather change due to once-through cooling on a large water body is a small local increase in fogginess at the plant outfall. But the relative probability of significant local meteorological effects is much higher with alternate cooling procedures, since these reduce the area of heat and moisture transfer. It is therefore concluded that, from a meteorological point of view, the least undesirable way to dispose of waste heat is by using once-through cooling on large water bodies. (auth)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts: 46083 and 47203.

General Detectors and Monitors

Refer also to abstracts: 45261 and 45673.

45585 (AERE-HP/M-74) MONITOR FOR ESTIMATING TRITIUM IN URINE. Booker, D. V.; Megaw, W. J.; Pittendrigh, L. W. D. (Atomic Energy Research Establishment, Harwell (England)). 29 Apr 1954. 9p. Dep. NTIS (U. S. Sales Only).

The use of an ionization chamber to determine levels of tritium present in urine is described. Acetylene from the action of urine on calcium carbide is passed through the chamber and from the ionization current reading, levels of tritium from 0.1 to 12 maximum permissible levels can be determined. (auth)

45586 (ARH-2432) RELATIVE EFFICIENCY AS A FUNCTION OF TIME FOR ATLANTIC RICHFIELD HANFORD COMPANY COAXIAL Ge(Li) DETECTORS. Zimmer, William H. (Atlantic Richfield Hanford Co., Richland, Wash.). May 1972. Contract AT(45-1)-2130. 35p. Dep. NTIS.

The performance and recovery of four detector systems are reported as typical of Ge(Li) detector performance at Hanford. (auth)

45587 (BNL-50332) OPERATING CHARACTERISTICS OF NEUTRON WELL COINCIDENCE COUNTERS. Sher, R. (Brookhaven National Lab., Upton, N. Y.). 1 Jan 1972. 47p. Dep. NTIS.

The neutron well coincidence meter consists of a bank of thermal neutron detectors, either BF_3 or ^3He counting tubes, embedded in a moderating medium (usually polyethylene) for detecting spontaneous fission neutrons from Pu sources in the presence of a large random background. The detector system has principally been used to determine ^{240}Pu contents of Pu-bearing samples such as feed material and fabrication plant output. Measured properties including efficiencies, linearity, geometric effects, matrix effects, and self-multiplication effects are discussed. A detailed description of the electronics is given, and dead-time corrections are discussed. Uncertainty considerations including statistical errors and calibration errors and the dependence of uncertainty on count time and source strength are detailed. Representative data obtained under field conditions with the neutron well coincidence counters are given. (W.H.K.)

45588 (COO-2114-2) EFFICIENCY STUDIES OF PILOT Y, PILOT F, AND NE 110 SCINTILLATOR. Messner, Robert; Nauenberg, Uriel (Colorado Univ., Boulder (USA). Duane Physical Lab.). 1972. 6p. Dep. NTIS.

The scintillators tested had dimensions of $24'' \times 2'' \times \frac{1}{8}''$. The efficiency was measured as a function of position along the long dimension. It was found that only Pilot Y plastic scintillator had a constant counting efficiency over the range of 24". (3 figures) (R.W.R.)

45589 (JEN-247) NEW APPROACH TO $\beta-\gamma$ COINCIDENCE COUNTING. ADVANCE REPORT ON THE "SAMAR" ELECTRONIC SYSTEM. De Carlos, J. E.; Granados, C. E. (Junta de Energia Nuclear, Madrid (Spain)). 1972. 47p. (In Spanish). Dep. NTIS (U. S. Sales Only).

In $4\pi\beta-\gamma$ coincidence measurements, precision on the evaluation of coincidence counting losses is made difficult because of complex overlapping effects between the β- and γ-side dead times due to precursive counted events. In this context the SAMAR electronic system is aimed to give a precise way of automatic counting and reduce the need for calculated corrections. The configuration and basic features of the SAMAR are described. The SAMAR has been conceived in such a manner that both beta and gamma chains are sharing a common and nonextending dead time which is simultaneously applied to both channels. The shared dead time is made to be the only one inserted throughout the chains. Overlapping effects vanish and the three counting channels have identical transmission ratios. A new dead time circuit based on fast linear gates as blocking elements has been developed. Application of the two-oscillator Mueller's method evidences a fully non-extending character. Automatism is implemented by using a live timer corrective channel controlling the counting scalers. (auth)

45590 (ORNL-tr-2532) COMPARISON OF THE BACKGROUND SPECTRA IN EIGHT GERMAN WHOLE-BODY COUNTERS AND A MODEL STRUCTURE WITH LAYERED SHIELD. Futtermenger, W. (Technische Universitaet, Hanover (West Germany)). Translated for Oak Ridge National Lab., Tenn., from report ABS-TUH-1065. 14p. Dep. NTIS.

The sources of background radiation in whole-body counters are discussed including radiation from wall material, cosmic radiation, radon radiation from the interior of the whole-body counter, and contamination and radiation from built-in instruments. The background spectra in eight German whole-body counters and a model structure were measured and compared. The various shielding designs used in the facilities are described and the construction costs listed and compared. (W.H.K.)

45591 MEASUREMENTS OF THE ABSOLUTE RADIATIVE EFFICIENCY OF CATHODOLUMINESCENT PHOSPHORS. Meyer, V. D. (Bayside Research Center, N. Y.). J. Electrochem. Soc.; 119: No. 7, 920-6(Jul 1972).

The absolute efficiency of cathodoluminescent phosphors was measured as a function of voltage and current density. The results are in good agreement with the highest values previously reported. Changes of slope in the luminance vs voltage curves indicate that changes in the voltage dependence may occur at x-ray excitation potentials; these observations are related to results reported by others for x-ray excitation of scintillation crystals. The indications are that it may not be possible to assume that the intrinsic efficiency is independent of the kinetic energy of the incident electron beam unless the energy exceeds the K x-ray levels of the host. (auth)

45592 APPARATUS FOR CONTINUOUS MEASUREMENT OF ACTIVE UPTAKE OF RADIOACTIVE SUBSTANCES. Loos, Eckhard (Univ., Regensburg, Ger.). Anal. Biochem.; 47: No. 1, 90-101(May 1972).

An apparatus is described allowing the registration of uptake kinetics of radioactive compounds by cells. Cells are held in a thin layer close to a scintillation crystal so that uptake of a labeled compound is seen as an increase in measured radioactivity. As a demonstration of the method, accumulation and countertransport kinetics are shown with 3-O-[^{14}C]-methyl-D-glucose for Chlorella vulgaris and for conidia of Neurospora crassa; for Chlorella a K_m of 6×10^{-4} M is found for the uptake. Parallel experiments with the membrane filter technique show good agreement and can be used to calibrate the apparatus. (6 figures, 1 table) (auth)

45593 SUBTRACTION AND POSITRON SCANNING WITH THE DUAL HEADED WHOLE BODY SCANNER. Saegusa, Kenji; Kakehi, Hirotake; Arima, Akira (Chiba Univ., Japan). Radioisotopes (Tokyo); 21: No. 6, 342-7(Jun 1972). (In Japanese).

The 5 in. dual headed whole body scanner, which is used in routine tests, has three operation modes of addition, subtraction, and positron scanning besides the ordinary one. The diagnostic usefulness of the subtraction and positron modes was studied. The word "subtraction scanning" in this study has different meaning from the usual subtraction technique. In this subtraction method, the image on the scintigram can be made by counting differences of output signals from upper and lower detectors. Therefore, two scintigrams, positive and negative, can be obtained simultaneously. Collimators of good resolution are not always necessary for this technique. Positron scanning is one of the established scanning techniques. However, unless the sensitivity of crystal is high enough, it is usually difficult to get a good result. In this study two detectors were used, one with a focusing collimator and the other with no collimator. Both scannings, subtraction and positron, have less counting dots on the scintigrams compared with the ordinary scanning. If larger doses of radioisotopes with shorter half-lives and with no beta particles are used, scintigrams of good contrast and sharp quality can be obtained by these techniques. (auth)

45594 EFFECT OF TEMPERATURE ON VARIOUS TYPES OF THE IONIZATION CHAMBER. Okabe, Shigeru; Tabata, Tatsuo; Tsumori, Kunihiko. Annu. Rep. Radiat. Center Osaka Prefect.; 12: 45-8(1971).

The dependence of ionization current on temperature was investigated for various types of the chamber by using pulsed X rays from a linear electron accelerator and γ rays from a ^{60}Co source. In the glass-wall and the metal-wall chambers equipped with parallel-plate electrodes of Au and filled with various kinds of gases, both average and peak ionization currents decreased rather remarkably with increasing temperature. In the cylindrical chamber having a cylindrical Au-electrode, the currents showed

a smaller decrease. Possible causes of the temperature effect are briefly discussed. (auth)

45595 TELEVISION TYPE NUCLEAR RADIATION CAMERA SYSTEM. Asars, Juris A.; Schneeberger, Robert J. (to CGR Medical Corp.). U. S. Patent 3,668,396. 6 Jun 1972. Filed 10 Nov 1969.

A television type camera system in which TV type scanning is used for readout of a spatially distributed nuclear radiation image is described. The scanning system provides means of time integration of the video pulses derived from a single radiation event and provides discrimination of the integrated pulses generated by a single event in the spatially distributed image. In one embodiment of the invention, conventional TV scanning is utilized and circuitry is associated with the system to permit time integration of the multiple video pulses derived from a single event for subsequent discrimination. A second embodiment utilizes a nonconventional scanning system to permit the electron scanning beam to stop and integrate a single event and subsequent discrimination of the signal. (auth)

45596 SCINTILLATION CAMERA HAVING IMPROVED PERIPHERAL RESPONSE. Walker, William G. (to Nuclear-Chicago Corp.). U. S. Patent 3,668,395. 6 Jun 1972. Filed 17 Dec 1969.

A substantial increase in the diameter of the useable light image generated by a scintillation camera equipped with a multiple collimator is achieved by using a collimator that does not include holes which allow radiation to strike the periphery of the scintillator. (auth)

45597 NUCLEAR RADIATION DETECTION DEVICE UTILIZING DIAMOND DETECTOR WITH INJECTING AND BLOCKING CONTACTS. Kozlov, Stanislav Fedorovich. U. S. Patent 3,668,400. 6 Jun 1972. Priority date 11 Sep 1968, Russia.

A device for detecting nuclear radiations, comprising a nuclear radiation detector based on a diamond crystal plate, having a blocking and an injecting contact, a detector power supply associated with the injecting contact, and an amplifier with recording means associated with the blocking contact, is described. (auth)

45598 NEW READING SYSTEM FOR AN IONOGRAPHIC DETECTOR. Chapuis, A. M. (CEN, Fontenay-aux-Roses, France); Soudain, G.; Gerard, N. Radioprotection; 7: No. 1, 13-20(1972). (In French).

The track density may be obtained from an ionographic detector from measurements of the light transmitted by the detector, which incorporates a thin film of colored cellulose nitrate in which holes correspond to the particle tracks. Results obtained with a U source and radioactive aerosols are presented. (France)

45599 SCATTERED NEUTRONS AND THEIR EFFECTS ON THE CALIBRATION OF BONNER SPHERE COUNTERS. Heinzelmann, M.; Rohloff, F.; Schueren, H. (Kernforschungsanlage, Juelich, Ger.). Atomkernenergie; 19: No. 4, 312-16(Jul 1972). (In German).

The efficiency of Bonner sphere counters has been measured by use of an Am–Be–neutron source. Special attention has been given to the variation of measured counting rate due to scattered neutrons at different scattering levels. Measurements have proven that the hypothesis of a quadratical dependence on distance and a scattering rate independent of distance gives as good results as an additional evaluation of an effective center of the Bonner sphere. Measurements at a very large distance from the source are prone to give too high values of efficiency, as the scattering rate is no longer constant for distances greater than one meter. (auth)

45600 FRONTIERS IN RADIATION DETECTION. Res./Develop.; 23: No. 5, 24-6(May 1972).

The development of cadmium telluride, gallium arsenide, and mercuric iodide semiconductor detectors is briefly discussed. (W.H.K.)

45601 QUANTITATIVE EVALUATION OF RADIOISOTOPE DISTRIBUTION IN VIVO BY ISOSENSITIVE SCANNER PLUS 4096-WORD MULTI-CHANNEL ANALYZER COUPLING. Hisada, Kin-ichi; Kojima, Kazuhiko; Matsudaira, Masamichi; Hiramatsu, Hiroshi (Kanazawa Univ., Japan). Radioisotopes (Tokyo); 21: No. 6, 348-52(Jun 1972).

In an isosensitive radioisotope scanning system the delineation of the radioisotope distribution is completely independent of depth. The coupling of a 4,096-word multi-channel analyzer to the isosensitive scanner makes it possible to evaluate radioisotope distribution in vivo quantitatively and provides various new diagnostic tools; for example, spleen/liver ratio, pancreas/liver ratio, profile histogram of lung perfusion scan, and tumor net counts in brain scan. (auth)

45602 USE OF A CONVERGENT HOLE COLLIMATOR FOR TRANSMISSION SCINTIPHOTO AND FOR THE COMBINED X-PHOTO AND SCINTILLATION IMAGE. Saito, Hiroshi; Tamiya, Tadashi (Nagoya Univ., Japan). Radioisotopes (Tokyo); 21: No. 6, 338-41(Jun 1972). (In Japanese).

Transmission scintiphotos were taken using a gamma-ray point source and a convergent 1261 hole focusing collimator. In addition, X-photo and scintillation images taken by keeping the X-ray tube-film distance equal to focus-scintillator distance had the same rate of magnification and both the images were superimposable. If an attachment is used to reproduce the same geometry in recording scintillation image and X-photo, these images can be double exposed on the same X-ray film. Thus the localization of the scintillation image can be easily determined especially in combination with X-photos. The present method would be useful not only for diagnosis, but also for therapy. (auth)

45603 RADIATION CONTROL AND MONITORING SYSTEM. Bean, Laurence R. (Univ. of Kentucky, Lexington). J. Amer. Dent. Ass.; 85: No. 1, 90-3(Jul 1972).

A device that can be installed in existing dental X-ray units to control and monitor radiation exposure to the patient is described. The radiation control unit emits a preset value of radiation and terminates the exposure. The attached printing device prints information set on the machine, such as milliroentgen values and kilovoltages, the tooth number, and data. The device utilizes an ionization chamber. (auth)

45604 PROLONGED ETCHING FACTOR IN SOLID STATE TRACK DETECTION AND ITS APPLICATIONS. Khan, H. A.; Durrani, S A. (Univ. of Birmingham, Eng.). Radiat. Eff.; 13: No. 3-4, 257-66(Apr 1972).

It was observed that the number density of etch pits resulting from spontaneous or induced fission within a solid state track detector (SSTD) is a function of the duration of etching, other conditions being constant. As the etching proceeds, the net number of etch pits observed per unit area continues to increase. This necessitates a modification of the conventional equations governing the observed etch-pit densities in SSTD. A prolonged etching factor f(t) is defined, and its value measured as a function of time under various specific etching conditions, in a number of materials of interest, including "reference glass". Furthermore, the theoretical relationship of this factor with the general velocity of etching in a given material, and with the average range R of fission fragments in it, is utilized in deriving self-consistent and very satisfactory values of R in the above-mentioned materials. (auth)

45605 DIRECTIONAL PROPERTIES OF CYLINDRICAL SCINTILLATORS SCREENED BY A SLEEVE-TYPE SCREENING. Petr, Ivo. Jad. Energ.; 18: No. 7, 233-6(Jul 1972). (In Czech).

The suitability of using a sleeve-type lead screening of maximum thickness 1 cm for obtaining directional detection properties for gamma-rays is discussed. The mathematical expressions for the detection cross section are derived and the value of the effective linear absorption coefficient of the shielding was determined from the comparison of theoretical and experimental results. Finally, the upper energy limit where the screening is suitable is determined. (auth)

45606 SPECTRAL AND SCINTILLATION PROPERTIES OF THE PYRIMIDINE DERIVATIVES. Visotskaite, S. B.; Zhurauskene, E. A.; Paeda, R. I.; Yasinskas, L. L.; Kundra, A. A. (Vilnyus State Univ., USSR). Liet. Fiz. Rinkinys; 11: No. 5, 871-80(1971). (In Russian).

The absorption and fluorescence spectra of 29 derivatives of pyrimidine were investigated. The scintillation properties of the pyrimidine derivatives were also examined. The relative scintillation efficiency of the above compounds used as primary soluble substances is 13 to 30% in comparison with PPO and p-terphenyl in dioxane. As secondary soluble substances some of them increase the counting efficiency in PPO and p-terphenyl scintillators in dioxane. (3 figures, 2 tables) (auth)

45607 NEW TWO-CHANNEL SCANNER: THE SCINTICART NUMERIC T. II. EXPERIENCES IN PRACTICE. Krasznai, I. (Belgyogyaszati Klinika, Budapest); Foeldes, J.; Billing, A.; Ambro, P. Izotoptechnika; 15: No. 1, 37-45(Apr 1972). (In Hungarian).

The results of experiments using phantoms and their application to clinical situations are presented. (8 figures, 1 table) (auth)

45608 PREAMPLIFIER FOR CHERENKOV SPECTROMETER. Khurshudyan, L. S.; Muradyan, E. G. (Inst. of Physics, Erevan). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 6: No. 3, 223-5 (1971). (In Russian).

Some peculiarities in the linear transmission of nanosecond pulses from radiation detectors by emitter follower into a cable with small wave impedance are considered, the feeding of the preamplifier being by the same coaxial cable as that transmitting the signal. A practically useful circuit for a preamplifier providing a transmission (with nonlinearity not worse than 1%) of pulses with a magnitude from 0.008 to 8 volts and duration from 10 ns to 10 ps into a cable with an impedance of 50 ohms is described. (1 figure) (auth)

45609 DEVICE FOR CONTROLLING SLOW DRIFT IN IONIZATION CHAMBERS. Dalmazzone, Jean (to Commissariat a l'-Energie Atomique). French Patent 2,083,752. 22 Nov 1971. Filed 26 Mar 1970. (In French).

A device for controlling slow drift in a dc ionization chamber is presented. A reference chamber containing a fixed weak radiation source of long half-life is placed in parallel with the measurement ionization chamber. A switching system permits the connection (separate or in parallel) of the reference chamber and the measurement chamber to an associated electronic unit. According to the construction the monitor may have its own atmosphere, or an atmosphere joined to the common atmosphere; it contains a ^{14}C or ^{241}Am source; the switching system may be a highly insulated single or double switch. (France)

45610 USE OF SOLID TRACK DETECTORS IN REACTOR EXPERIMENTS. Kuznetsov, V. A.; Mogil'ner, A. I.; Koroleva, V. P.; Samovarov, V. S.; Chernov, L. A. At. Energ. (USSR); 32: No. 6, 481-3(Jun 1972). (In Russian).

Methods of utilizing nitrocellulose for recording α particles (from ^{10}B and ^{6}Li) and mica for recording ^{235}U fission fragments were investigated. The nitrocellulose was in the form of motion picture film or x-ray film, for which the following etching conditions are suggested: 30% NaOH, 60°C, for 15 min. Etching of the mica was conducted with 40% HF, 60°C, for 30 min. (7 figures) (K.S.W.)

45611 APPLICATION OF TRACK STRUCTURE THEORY TO DOSIMETRY AND RADIOBIOLOGY. Homayoonfar, Mehdi. Lincoln, Nebr.; Univ. of Nebraska (1971). 258p. University Microfilms Order No. 72-15,988.

Thesis.

By the application of δ-ray theory, a model for cell survival after energetic ion bombardment is proposed. The survival curves for some cells are both sigmoid and exponential types, and are accounted for on the conceptual basis of ion-kill and gamma-kill modes and multitarget single-hit survival hypothesis. Tracks formed in nuclear emulsion by energetic heavy ions are made up of grains sensitized by the passage of a single ion in a model called ion-kill. The response of cells is not the same as emulsion grains, because cells also can be inactivated by a gamma-kill mode, involving the cumulative effects of overlapping δ rays from several ions. Survival curves are calculated and compared with experimental survival data for T-1 human kidney, HeLa, Chinese hamster, haploid yeast, and bacterial spores. The proposed model is extended to those cells whose experimental survival curves have big shoulders to x and gamma rays and heavy ions. The cellular model is further extended to the problem of radiation therapy and mixed radiation environments like neutrons and stopped pions. The predicted survival curves for this mixed radiation are compared with existing experimental data for T-1 human kidney as well as HeLa cells irradiated with 14-MeV neutrons; agreement is good. The δ ray theory was extended to analyze the response of various detectors like the LiF thermoluminescent dosimeter, the Fricke dosimeter, the silver-activated phosphate glass dosimeter, the creation of free radicals in solid biological substances, solid and liquid organic scintillators and other systems. The results show that all are well described by the application of the δ-ray theory. Difficulties arising from the use of LET as a major and basic tool to describe radiation quality, cross section, radiosensitivity, OER, RBE, etc., are discussed. (TSS) (Diss. Abstr. Int., B)

45612 TRACK EFFECTS IN PHYSICAL, CHEMICAL, AND BIOLOGICAL SYSTEMS. Sharma, Subhash Chander. Lincoln, Nebr.; Univ. of Nebraska (1971). 231p. University Microfilms Order No. 72-16,014.

Thesis.

The universal applicability of the delta-ray theory of the track structure associated with heavy ions to several physical, chemical, and biological systems is shown. The theory is extended to various radiation detectors like the silver-activated phosphate glass dosimeter, the LiF thermoluminescent dosimeter, the creation of free radicals in solid biological substances (esr experiments), solid and liquid organic scintillators, and the chemical systems like the ferrous sulphate (Fricke) dosimeter. The theoretical yield curves are in good agreement with experimental data. No saturation cross section is observed for these detectors. The nonlinearity and the multiple valuedness of the response curves for various radiation detectors are consequences of the characteristic dose and the size of the sensitive element. Variables describing the bombarding ion and those describing the medium are not separable. A cell model is proposed which accounts for the survival curves observed when elementary biological systems are bombarded with heavy ions on the basis of a 1-hit multitarget survival hypothesis. The dosage of ionization energy deposited by the delta rays from a single ion may itself inactivate a cell along the ion's path. This is most likely to occur at high specific energy loss. Since cells remember, cells not inactivated by a single ion may be inactivated by cooperative effects from several ions. Survival curves are calculated and compared with experimental data for spores, yeast, and various mammalian cells. The model proposed for cell radiation response is further applied to the prediction of cell survival curves for 14-MeV neutrons, stopped negative pions, and any radiation which gives rise to secondary charged particles whose energy spectrum is known. The models proposed were also investigated for predicting the radiation hazards and detection of heavy ions in cosmic rays. (TSS) (Diss. Abstr. Int., B)

45613 SEQUENTIAL SAMPLER. Teel, Dale M.; Putnam, John H. Jr. (to United States Atomic Energy Commission). U. S. Patent 3,657,920. 25 Apr 1972. Filed 6 May 1970.

A sampler for collecting a series of samples of aerosols from the atmosphere is described. The sampler utilizes a removable head having several sampling units, which are sequentially actuated to obtain samples at regular intervals over long periods of time. The head carrying the sampling units is readily replaceable, and the whole device is designed for remote operation. (2 figures) (auth)

45614 MINIATURE LOW-BACKGROUND COUNTERS FOR MEASUREMENT OF ^{37}Ar AND ^{39}Ar. Fisenko, A. V.; Kolesnikov, E. M. (Inst. of Pure Chemistry and Analytic Chemistry, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 6, 1654-5 (1971).

Translated from Prib. Tekh. Eksp.; 14: No. 6, 62-3(1971).

The construction of miniature counters having an internal filler which is used to measure ^{37}Ar and ^{39}Ar, while operating in either the Geiger or proportional modes, is described. Information is presented on the magnitude of the background as a function of cathode material, cathode thickness, or the voltage on the guard electrodes. (auth)

45615 RECORDING OF ALPHA PARTICLES BY SOLID TRACK DETECTORS BASED ON CELLULOSE. Bondarev, V. N.; Korzin, E. G.; Parfanovich, D. M. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 6, 1648-50(1971).

Translated from Prib. Tekh. Eksp.; 14: No. 6, 56-9(1971).

A study was made of solid track detectors based on cellulose. For films made of nitro- and acetyl-cellulose the energy ranges of α particles which can be recorded with 100% efficiency are established, and the dependences of the track dimensions of α-particle energy are obtained. The results of measurements of the space distribution of the density of thermal-neutron capture in a boron absorptive rod having a small diameter measured by means of a nitro-cellulose detector are presented. (auth)

45616 TIME MEASUREMENTS WITH A GERMANIUM DETECTOR. Akimov, Yu. K.; Andert, K.; Kalinin, A. I.; Churin, I. N.; Shuravin, V. N. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 6, 1641-4(1971).

Translated from Prib. Tekh. Eksp.; 14: No. 6, 51-4(1971).

A low-noise preamplifier with a rise time of 5 nsec and a fast shaper with compensation of the dependence of the time resolution on amplitude scatter and on changes in the leading edge of the pulses was developed for time measurements with a germanium detector. In recording γ quanta from ^{60}Co by a germanium detector having a volume of 3 cm^3 connected in coincidence with a scintillation counter, a time resolution of 2.2 nsec was obtained in the energy range from 0.07 to 1.33 MeV; the width of the coincidence curve at the 0.1 curve-height level was 12.5 nsec. In a narrow energy range a time resolution of 0.9 nsec was obtained. (auth)

Radiation Dosimeters

Refer also to abstracts: 45672 and 45808.

45617 (FEI-296) STUDY OF THE CHARACTERISTICS OF EMERGENCY TRACK DETECTORS. Obaturov, G. M.; Chumbarov, Yu. K. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1971. 30p. (In Russian). Dep. NTIS (U. S. Sales Only).

Mica track neutron detectors with layers of ^{237}Np, natural U,

and ^{238}U were investigated; and on the basis of the results a track dosimeter was designed with two layers of natural U and a layer of ^{238}U and ^{237}Np, making it possible to determine neutron doses for both the whole energy spectrum and for various energy intervals with acceptable accuracy. Results are given of comparative studies of track dosimeters, thermoluminescent dosimeters, and tissue-equivalent, low-efficiency Geiger counters for critical assemblies. (tr-auth)

45618 (ICRU-21) RADIATION DOSIMETRY: ELECTRONS WITH INITIAL ENERGIES BETWEEN 1 AND 50 MeV. (International Commission on Radiation Units and Measurements, Washington, D. C.). 15 May 1972. 64p. ICRU Publications, Washington, D. C. $4.00.

The basic parameters of electron beams are discussed including the determination of electron energy, energy spectra of electron beams, measurement of energy fluence, and energy loss and multiple scattering. General concepts in determining electron absorbed dose are discussed; and calorimetric methods, ionization methods, chemical methods, and solid state methods are considered and compared. Electron beam monitors are discussed under the headings: transmission ionization chambers, secondary emission monitors, induction monitors, partial beam monitoring by ionization chambers, partial beam monitoring by collection of electrons, stability of monitors as a function of machine operating conditions, and choice of monitor. Measurement and control of beam characteristics including determination of the virtual source, beam direction, and beam profile, and measurement of fluctuations of beam direction and beam energy are discussed. Determination of absorbed dose at a reference point, calibration of dosimeters, determination of the absorbed dose in water at any point in the phantom, phantoms, factors influencing the absorbed dose distribution, and beam contamination by bremsstrahlung and neutrons are examined. The energy range (1 to 50 MeV) was chosen to include radiations produced by linear and circular accelerators and which are mainly used for medical, radiochemical, and radiobiological purposes. An extensive list of references is included. (W.H.K.)

45619 IMPORTANCE OF TISSUE-EQUIVALENT DETECTORS USED IN RADIOMETRY. Frolova, A. V.; Kolotilova, V. G.; Krongauz, A. N.; Shagimardanov, N. Sh. (Moscow Scientific-Research Roentgeno-Radiological Inst.). Med. Radiol.; 16: No. 12, 62-5(Dec 1971). (In Russian).

Computer calculations are given for the elemental composition of plastic tissue-equivalent scintillators used for long-wave x radiation. The effective atomic number should be different for different radiation energies, and disregard of this fact results in error in the determination of the absorbed dose and especially its distribution throughout the irradiated volume. (tr-auth)

45620 DOSE-RATE MEASUREMENT BY SEVERAL RADOCON PROBES. II. Kanazawa, Tamotsu; Ohnishi, Tokuhiro; Furuta, Junichiro. Annu. Rep. Radiat. Center Osaka Prefect.; 12: 81-3(1971).

In the dose-rate measurements of gamma-rays, the observed values by a Radocon probe are often found to change to lower values. The experiments were performed to check the causes for this change. The deterioration and the temperature rise of the probe by gamma-irradiation are considered to be the causes. (auth)

45621 PHANTOM-DOSIMETER WITH LIQUID-FILLED IONIZATION CHAMBER. Linchevskaya, G. A.; Luk'yanov, L. A. (Moscow Research X-Ray Radiological Inst.). Med. Radiol.; 17: No. 3, 87-9(Mar 1972). (In Russian).

A measuring instrument consisting of an ionization chamber filled with a tissue-equivalent liquid, a special small-size source of stabilized high tension, and a Y-2 type electrometric amplifier is described. The liquid-filled ionization chamber measures directly the ionizing radiation energy absorbed in the tissue-equivalent medium (i.e. it plays the part of a radmeter). The liquid-filled chamber is encased in a housing made of plexiglas and there is also a set of plates of varying width which are placed on both sides of the liquid-filled detector and can be taken off and interchanged with various tissue- and bone-equivalent plates (phantoms). The main purpose of the proposed as a detector phantom-dosimeter is dosimetry of radiations within a broad range of energies (x-rays, gamma rays, high-energy bremsstrahlung, neutrons, and protons). (auth)

45622 THERMOLUMINESCENT DOSIMETRY SYSTEM FOR DETERMINING QUALITY. Szymczyk, W.; Byrski, E.; Polak, B. (Inst. of Oncology, Krakow). Radiobiol.-Radiother.; 12: No. 6, 797-801(1971).

Two thermoluminescent phosphors LiF: Mg, Ti and CaF_2: Mn made in Poland were used for effective energy determination of an X-ray beam penetrating a water medium. The results obtained are compared with the published data. (auth)

45623 COMMERCIAL THIMBLE CHAMBERS FOR ABSORBED DOSE MEASUREMENTS AT HIGH ENERGY ELECTRON RADIATION. Svensson, H.; Pettersson, C.; Hettinger, G. (Umeaa Univ., Sweden). Acta Radiol., Ther., Phys., Biol.; 10: No. 5, 504-12(Oct 1971).

The absorbed dose calibration factors for 6 types of commercial thimble ionization chambers at the point of maximum absorbed dose were determined with electron beam energies between 8 and 30 MeV. The influence of several correction factors dependent on the chamber construction are discussed. The properties of a thimble ionization chamber suitable for absorbed dose measurements in high energy electron beams are summarized. (auth) (Sweden)

45624 PRESENT STATUS OF PERSONNEL DOSIMETERS. Moriuchi, Yasuyuki. Nippon Genshiryoku Gakkaishi; 14: No. 6, 295-306(Jun 1972). (In Japanese).

Basic considerations on the significance of personnel dosimeters are discussed; these are followed by an analytic examination of the factors that affect the precision and accuracy of the dose measurements. The factors are classified into the following four categories: theoretical characteristics based upon the dose measuring principles, quality control techniques applied to the detector elements and measuring instruments, techniques of pre- and/or post-irradiation treatments, and techniques of normalization against dose standards. Four kinds of personnel dosimeters currently used in Japan (film badge, pocket dosimeter, glass dosimeter, and thermoluminescent dosimeter) were inspected in accordance with the national exposure standards issued by ETL. The results obtained are presented with reference to systematically and objectively reconsidered theoretical characteristics such as the energy response and to data indicating the level of reliability of personnel dose monitoring systems available today in Japan. The results reveal that the reliability is largely dependent on the suitability of the monitoring system for securing good traceability against the dose standards and on proper post-irradiation treatment. It is concluded that among the four kinds of dosimeters, the film badge system sometimes appears to be most doubtful in accuracy. In view of the increasing importance of measurements of genetically significant dose, medically considered scattering radiation dose, and environmental radiation dose, the reliability of the available personnel dose measurements would appear to call for improvement the world over. (15 figures, 1 table) (auth)

45625 DOSIMETRY PROBLEMS WITH BREMSSTRAHLUNG IN THE GeV RANGE. Zywietz, Friedrich (Univ., Hamburg). Stud. Biophys.; 23: No. 1, 61-8(1970). (In German).

An experimental determination of the absorbed dose of high-energy bremsstrahlung (E_{max} = 6200 MeV) was undertaken using the ferrous sulfate dosimeter. The experiments were carried out at the Deutsches Elektronen-Synchrotron (DESY). The irradiation technique, the beam properties, and the dosimetry are described. From the irradiation of the ferrous sulfate solution in a 6.2-GeV photon beam and the data of the time-integrated quantum flux by a quantameter a dose–flux relation of 0.73×10^{-7} rad/Q_{eff} cm^{-2} resulted. For the calculation of the absorbed dose, a G value of 15.6 was used. The development of the electromagnetic cascade in a water phantom leads to an increase in dose rate with depth, and this was measured with the ferrous sulfate dosimeter for various energies. (5 figures) (auth)

45626 MICRODOSIMETRY MEASUREMENTS OF FAST NEUTRONS WITH A TISSUE-EQUIVALENT PROPORTIONAL COUNTER OF 1 CM DIAMETER. Krueger, H.; Graul, E. H. (Philipps-Univ., Marburg, Ger.). Stud. Biophys. 23: No. 1, 27-36(1970). (In German).

For neutron-therapy investigations it is important to know not only depth-dose curves but also the changes of radiation quality in the human body. A ball-shaped tissue-equivalent proportional counter of 1 cm diameter, which was built for this purpose, is briefly described. LET spectra as well as the spectra of "local specific energy" and their depth-dependent changes were inferred from the microdosimetric measurements made with the proportional counter in a tissue-equivalent trunk phantom. Discussions of the spectra measured are included. (8 figures) (auth)

45627 DOSIMETRY OF PULSED X-RAYS AND ELECTRONS FROM A LINEAR ACCELERATOR. Antoku, Shigetoshi; Sunayashiki, Tadashi; Takeoka, Seiji; Takeshita, Kenji (Hiroshima Univ.). Hiroshima Daigaku Genbaku Hoshano Igaku Kenkyusho Nenpo; No. 12, 69-76(1971). (In Japanese).

To use ionization chambers for dosimetry of pulsed radiations from the accelerator, the ion-recombination and energy dependence of the ionization chambers were studied by comparing them with chemical and thermoluminescence dosimeters. The ionization chambers indicated lower readings than the true values by recombination of ions. Readings of an Ionex 0.6-cc chamber were

about 20 percent lower than those of the chemical and thermoluminescent systems, at a dose rate of 1,500 rad/min (1.7 esu/pulse). The collection efficiencies of Ionex and Radocon dosimeters determined experimentally agreed with those calculated using 750 V · cm · esu as a constant μ in a theoretical formula. The sensitivity changes according to radiation and its energy were established for both dosimeters. The sensitivity increased by 7–9 percent for 10- to 30-MeV electrons and decreased by 0–5 percent for 10- to 35-MV x-rays according to a ^{60}Co γ-ray standard. Field homogeneities in effective fields (80% of total area) were less than 10 percent for both electrons and x-rays in the therapy mode. They were less homogeneous for x-rays in the research mode. It is difficult to infer a specific dose to biological materials using ionization chambers because of variations in collection efficiency by output from the accelerator. Lack of homogeneity of fields was able to be reduced by rotating the irradiation cage. (auth) (Japan)

45628 UTILIZATION OF ALUMINA RADIOTHERMOLUMINESCENCE IN ZONE DOSIMETRY. EXPERIMENTAL APPLICATION IN FRENCH NUCLEAR TESTS IN THE PACIFIC OCEAN. Portal, G. (CEN, Fontenay-aux-Roses, France); Marchal, P.; Medioni, R.; (and others). Radioprotection; 7: No. 1, 21-43(1972). (In French).

Roof tiles containing quartz and feldspars were used to estimate the radiation doses resulting from the atomic bomb explosions at Hiroshima and Nagasaki. This method might be used in other applications, for example, the dosimetry of criticality accidents. It was suggested that a large quantity of radiothermoluminescent material could be incorporated systematically in the bricks used in certain constructions. Investigations led to the selection of an industrial quality of aluminum oxide which could be marketed at a reasonable price. The crystallographic and chemical characteristics of this material were examined together with its radiothermoluminescent properties. The material presents a thermoluminescent curve having four energy levels. Only the deepest levels are utilized. With ordinary reading materials, measurements between 0.5 and 10^6 rads can be effected. This material is almost insensitive to neutrons, a property enabling it to be used in mixed fields. Dosimetry effected with alumina bricks in conjunction with French nuclear tests in the Pacific is presented. (France)

45629 PERSONAL PHOTODOSIMETRY IN RADIODIAGNOSIS AND RADIATION THERAPY ROOMS. Balon, Z. P.; Lyalina, L. I.; Kotov, G. V. (Central Scientific-Research Inst. of Roentgeno-Radiology, Leningrad). Med. Radiol.; 17: No. 5, 43-6(May 1972). (In Russian).

Results obtained by investigating characteristics of personal photodosimeters in a radiation range from 10 to 500 keV are summarized, and data from studies of a new improved personal photodosimeter are presented. Photodosimeters have an energy dependence within a range of 10 to 200 keV, the character of the sensitivity variations being similar for different types of photodosimeters and films. This restricts the possibility of using dosimeters for x-ray diagnosis and therapy. Methods of recording energy dependence in the x-ray range of 40 to 200 kV suggested by some authors may find practical use only after these recommendations will have been taken into account in designing the device under consideration with strictly standardized methods of measurements. (3 figures, 2 tables) (auth)

45630 COMPARISON OF NEUTRON AND GAMMA-RAY PERSONNEL DOSIMETERS AT CRITICAL ASSEMBLIES. Keirim-Markus, I. B.; Kraitor, S. N.; Kuz'min, V. V.; (and others). At. Energ. (USSR); 33: No. 1, 563-5(Jul 1972). (In Russian).

Comparative results of neutron and gamma-ray personnel dosimeters are presented. It is shown that data obtained by means of neutron-track dosimeters and thermoluminescent (CaS) dosimeters agree within 30% and, when measurements are conducted with sufficient statistical accuracy, 15%. There is agreement within the same limits for gamma-ray dosimeters: pocket film (IFK-2,3), glass (IKS), and LiF. The results obtained by means of neutron personnel dosimeters agree with LET spectra measured by a set of tissue-equivalent low-efficiency Geiger counters and neutron spectra measured by means of threshold detectors. (2 figures, 2 tables) (auth)

45631 FILM TECHNIQUE FOR DETERMINING THE ABSORBED DOSE AT EXIT FROM THE PATIENT DURING RADIATION EXPOSURE. Haus, A. G.; Strubler, K.; Marks, J. E. (Univ. of Chicago). Radiology; 104: No. 1, 197-200(Jul 1972).

A film technique for measuring the absorbed dose at exit from a patient during radiation exposure was studied with the ^{60}Co and Van de Graaff teletherapy machines. Film response was investigated at several field sizes and depths. Results indicate that a standard film calibration curve can be obtained to calculate absorbed dose. The treatment verification film is obtained by inserting the film in a thin vinyl flexible cassette which remains beneath the patient throughout the complete radiation exposure. The absorbed exit dose can be obtained from the verification film with the calibration curve. (auth)

45632 RADIO-FREQUENCY (OSCILLOMETRIC) ALCOHOLIC CHLOBENZENE DOSIMETER. Horvath, Zsuzsanna; Banyai, Eva; Foldiak, Gabor (Magyar Todomanyos Akademia Izotop Intezete, Budapest). Magy. Kem. Foly.; 76: No. 10, 504-5(Oct 1970). (In Hungarian).

Oscillometric analysis as a new method in alcoholic chlorobenzene chemical dosimetry makes possible direct measurement in sealed ampoules, thus reducing the duration of a measurement from 8 to 10 minutes (in the case of conventional titration method) to 1 minute. By performing a sufficiently large number of measurements, the accuracy and reproducibility of the dosimetric system may further be improved. As shown by the results of thousands of measurements, the method can be used for routine work (for a point-to-point determination of radiation fields of irradiation facilities, regular dose monitoring, etc.). (auth)

45633 INFLUENCE OF A CONTAINER'S MATERIAL FOR INDICATIONS RENDERED BY THE CHEMICAL METHYL-ORANGE DOSIMETER. Kalmykov, L. Z. (Kharkov Scientific Research Inst. of Medical Radiology). Med. Radiol.; 17: No. 6, 90-3(Jun 1972). (In Russian).

Evidence is offered proving that a methyl-orange solution in concentrations of $5 \cdot 10^{-6}$ M in a 0.01 M nitric acid, employed as a chemical dosimeter, may be exposed to irradiation in vessels made of paraffin, polymethylacrylate (plexiglas), polyethylene, and plastic polyvinyl chloride in addition to glass vessels. (auth)

45634 MEASUREMENT OF ABSORBED DOSES WITH FLUID IONIZATION CHAMBERS. Linchevskaya, G. A.; Luk'yanov, L. A. (Moscow Scientific Research Roentgeno-Radiological Inst.). Med. Radiol.; 17: No. 6, 80-3(Jun 1972). (In Russian).

The technique and results of direct measurements of absorbed radiation energy by means of ionization chambers using a tissue-equivalent fluid with high electric resistance (heptane + 3.5% HCl_4) are described. The operating principle of such fluid chambers is based on the fact that under the influence of ionizing radiation the conductivity of fluid dielectrics is increased. The dependence of the ionizing current on the electric field intensity in the chamber, dose, and radiation energy was investigated. Absorbed energy values in the operating volume of the fluid chamber were obtained. (auth)

45635 ABSORBED IONIZING RADIATION MEASURING DEVICE. Falk, Fred W. U. S. Patent 3,676,682. 11 Jul 1972. Filed 30 Oct 1968.

An ionization chamber for measuring absorbed radiation is disclosed. The chamber includes a housing which incorporates an anode, a cathode, and a space charge electrode. The anode comprises a conducting plate which has a plurality of protruding needle points with each of the needle points and the conducting plate being at the same electrical potential. The space charge electrode has a plurality of holes therein and is physically displaced from the anode with the holes of the space charge electrode being in registry with the needle points of the anode. The potential of the space charge electrode is less than that of the anode itself. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts: 45264, 46144, 46893, and 46966.

45636 (BARC-591) SIMPLE TRANSISTORISED CONTROL UNIT FOR NEUTRON CRYSTAL SPECTROMETERS. Shah, V. M.; Singh, Virender; Rao, K. R. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 15p. Dep. NTIS (U. S. Sales Only).

A simple transistorized version of a control unit which can be used for auto-control of neutron spectrometers is described. Although the basic circuitry is discussed in terms of operation of a triple axis spectrometer (or a filter detector spectrometer), the same unit can be used for control of a diffractometer used for studying powder samples. The system is found to be reliable and extremely simple to operate. The design incorporates features of sequential and parallel drive of several motors in the forward and reverse directions. This helps in an optimum time scan of phonons, several of them one after another. (auth)

45637 (JINR-P13-6428) SIGNAL FILTRATION IN THE AMPLITUDE SPECTROMETRY SYSTEMS. Vakhtel, V. M.; Semenov, B. Yu. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 23p. (In Russian). Dep. NTIS (U. S. Sales Only).

The following problems have been considered: (1) The production of the maximum signal-to-noise ratio in the standard systems. (When considering this problem the notion of the system weight (memory) function and that of the effective correlation coefficient are employed, which simplifies the procedure). (2) The achievement of maximally possible signal-to-noise ratio in the system of amplitude spectrometry. (3) The optimization of the parameter selection of some practically important types of RC-filters. (4) A proper choice of the time constant of the connecting RC-circuit between the amplifier and the analog-to-digital convertor. The Appendix covers the system memory function and its relation to a widely-known notion of the system impulse response. Also, the material is systematized concerning the ways of describing the signal, the noise, and the system characteristics. This material is necessary in solving filtration problems. (auth)

45638 MAGNETIC FIELD INVERSELY PROPORTIONAL TO r WITH A PERIODIC AZIMUTHAL INHOMOGENEITY. Saulit, V. R. (Leningrad State Univ.). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 1, 34-7(Jul 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 1, 48-53(Jan 1972).

A magnetic field antisymmetric with respect to the plane z = 0 is specified by the expression $H(r, \varphi) = 1/r \sum_{k=0}^{n} (a_k \cos k\varphi + b_k \sin k\varphi)$, where a_k and b_k are arbitrary coefficients. The field in the space adjoining this plane and the shape of the appropriate pole piece are determined. The problem is solved in finite form without series expansions. The surface of each pole piece has a relatively simple geometric shape, which is easy to reproduce; it is formed by the geometric locus of points on straight lines intersecting in a single common point. This field can be used in the spectrometry of charged particles with moderate energies. (1 figure) (auth)

45639 FAST–SLOW COINCIDENCE CIRCUIT SYSTEMS FOR Ge(Li) DETECTOR. Sato, Yuji; Azuma, Toshio. Annu. Rep. Radiat. Center Osaka Prefect.; 12: 22-7(1971).

To measure gamma-ray spectra from isotopes, a fast slow coincidence circuit system is tested. The resolving time of fast coincidence is 11 nsec FWHM for NaI-Ge. That of Ge-Ge is 21 nsec FWHM. A time-to-pulse height converter is used to measure short times of nsec order. The time delays between two inputs (NaI-Ge and Ge-Ge) are adjusted to make correct coincidence. (auth)

45640 SOURCE OF HIGH-INTENSITY NANOSECOND LIGHT PULSES. Elenskii, Ya. S. (Inst. of Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1165-6(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 183-4(Jul-Aug 1971).

It is shown that a pulsed gas laser may be used to simulate the passage of showers of high-energy particles, as well as individual particles, through a scintillation counter. In either case the spectra and duration of the luminescence are close to the simulated values. (auth)

45641 PULSED ACCELERATOR TIME-OF-FLIGHT SPECTROMETERS. Rae, Ernest R. (Atomic Energy Research Establishment, Harwell, Eng.). pp 1-99 of Experimental Neutron Resonance Spectroscopy. /Harvey, J. A. (ed.). New York; Academic Press, Inc. (1970).

The only technique that has proved successful for studying neutrons from 1 eV to 100 keV is that of neutron time of flight using a continuous-energy-spectrum neutron source. Although a number of accelerators can be used, the most versatile is the electron linac, and the bulk of this chapter is devoted to the present status of this device. The performances of a number of spectrometers are compared. The pulsed van de Graaff is also described, but its use is restricted to neutron energies above 2 keV. (52 figures, 3 tables, 166 references) (R.W.R.)

45642 MULTICHANNEL MODULAR SPECTROMETER FOR LOW-ENERGY ELECTRONS AND PROTONS. Vaisberg, O. L.; Zhurina, L. S.; Kovalenko, V. G.; (and others). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 6, 1631-3(1971).

Translated from Prib. Tekh. Eksp.; 14: No. 6, 42-4(1971).

An electron and proton spectrometer is described which is designed for measurement of the characteristics of charged-particle fluxes in the range of energies from 0.03 to 10 keV. An energy analysis of the particles is carried out by electrostatic analyzers, while detection is performed by channel electron multipliers. (auth)

45643 LOW-ENERGY-ELECTRON SPECTROMETER HAVING A MULTIPLATE ANALYZER. Lein, E. L.; Ol'dekop, L. G.; Polenov, B. V.; (and others). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 6, 1634-7(1971).

Translated from Prib. Tekh. Eksp.; 14: No. 6, 44-8(1971).

A spectrometer is described which was designed for studying a flux of electrons having an energy of from 1 to 10 keV. The use of multiplate analyzers having a relatively high resolution allowed the sensitivity of the flux-density measurements to be increased in the presence of ultraviolet radiation. The fundamental electronic sections and the block diagram of the instrument are described. (auth)

45644 X-RAY SPECTROMETER HAVING A COOLED Si(Li)-DETECTOR. Arl't, R. D.; Banifatov, A. E.; Kalinin, A. I.; Petrov, M. M.; Tyvin, L. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 6, 1638-40(1971).

Translated from Prib. Tekh. Eksp.; 14: No. 6, 48-50(1971).

An x-ray spectrometer with an Si(Li)-detector and a field-effect transistor mounted in a cryostat chamber is described. A resolution of 650 eV was obtained for the 6.4 keV line from ^{57}Co. (auth)

45645 CHARACTERISTICS OF CHARGED-PARTICLE DETECTION SECTIONS HAVING CHANNEL ELECTRON MULTIPLIERS. Kovalenko, V. G.; Polenov, B. V. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 6, 1651-3(1971).

Translated from Prib. Tekh. Eksp.; 14: No. 6, 59-61(1971).

The characteristics of the detection sections used in a low-energy charged-particle spectrometer are presented. The sections studied contain a cylindrical electrostatic analyzer and a channel electron multiplier having an input-window area 0.2 × 0.6 cm^2. (auth)

High Energy Physics Instrumentation

45646 (RPP/H–89) PLASTIC THRESHOLD CERENKOV DETECTORS WITH WAVELENGTH SHIFTER AND QUENCHER. Sacharidis, E. J. (Rutherford High Energy Lab., Chilton (England)). [nd]. 27p. Dep. NTIS (U. S. Sales Only).

Tests on the threshold behavior of plastic Cherenkov radiators containing a wavelength shifter and quencher are described and discussed. It is shown that they lead to improved photoelectron yield combined with angular uniformity and low scintillation level above 0.500 GeV/c. (auth) (UK)

45647 (UCRL–51214) PSEUDO CLOUD-CHAMBER TRACKS AND THEIR USES. Ernst, Richard D. (California Univ., Livermore. Lawrence Livermore Lab.). 13 Apr 1972. Contract W-7405-eng-48. 27p. Dep. NTIS.

Pseudo cloud-chamber tracks are artificial tracks superimposed by double exposure on otherwise normal photographs of real cloud-chamber tracks. The pseudo tracks were originally developed as a means of training scanners to look for low-density (quark) tracks; since then, many other uses have arisen. Such uses include (1) checking the model used in generating the pseudo tracks, (2) investigating the effects of using different gases in the model, (3) training scanners to hand-count tracks under a microscope, (4) normalizing the hand-counted data, (5) keeping the scanners alert by using the pseudo tracks as "carrots," (6) determining how efficient the scanners are in finding quark tracks (and in the process proving that such tracks can be found), (7) analyzing the automatic scanning system, and (8) studying the feasibility of new approaches to the search for quarks. (auth)

45648 DETECTOR FOR HIGH ENERGY PARTICLES BASED ON THE PRINCIPLE OF USING PARTICLE RADIATION IN A LAMINATED MEDIUM. Arutyunyan, F. R.; Nazaryan, A. A.; Torgomyan, F. B.; Frangyan, A. A.; Ekimyan, G. A. (Inst. of Physical Research, Erevan). Dokl. Akad. Nauk Arm. SSR; 53: No. 1, 11-15(1971). (In Russian).

The "resonance radiation detector" (RRD) is analogous to a Cherenkov counter, both in the concept of separating the direction of particle movement and in the threshold character of the radiation; but it differs from the Cherenkov counter in its ability to operate in the region of large values of E/mc^2. The authors had previously used the RRD in the detection of muons in cosmic rays. Experiments are reported here on the use of the RRD for 2.8- and 3.7-GeV electrons from a synchrotron. The beam of π^- and e^-, after passage through a laminated medium, entered a gas threshold Cherenkov counter and a full absorption Cherenkov counter. The latter separated the electrons from the beam of π^- mesons. (3 figures) (K.S.W.)

45649 BUBBLE DENSITY DETERMINATION IN BUBBLE CHAMBERS. Ganovici, I.; Nichitin, Fl. An. Univ. Bucuresti, Ser. Stiint. Natur., Fiz.; 19: 9-17(1970).

The gap distribution function was extended to negative gaps. The gap average length, size of the vacancies, and gap density were measured for two cases, viz. with and without consideration of the spots. Bubble density was measured from the average value of the bubble plus the spot size ($\bar{D}_{b+s}$). (Rom. Sci. Abstr.)

45650 PERFORMANCE LOGIC OF SPARK CHAMBER INFORMATION READ-OUT BY TELEVISION AUTOMATION AND DATA LINK TO A COMPUTER. Klevalin, V. A.; Belyakov, E. S.; Bernshtein, L. I.; Lebedev, B. A.; Petrakov, A. V. Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 6: No. 3, 219-22(1971). (In Russian).

The on-line performance logic for spark chamber readout by television automation coupled to a small Razdan-2 computer is given. The information is transferred to computer during the backward motion of a vidicon beam. The information transference of 6 tracks in the spark chamber takes 100 μs for each line for the direct motion of 300 μs. (3 figures) (auth)

45651 SYSTEMATIC METHODS FOR THE ANALYSIS OF A SAMPLE OF NUCLEAR INTERACTIONS IN HYDROGEN BUBBLE CHAMBER. Huq, S. S. (Univ. of Rajshahi, Pakistan). Nucleus (Karachi); 8: No. 4, 63-76(1971).

Systematic methods of analysis of some 15,000 bubble chamber pictures of nuclear interactions involving inelastic collision of a 5 GeV/c K^+ beam on proton giving rise to four charged secondary tracks are presented. Final state reactions of the type $K^+p \rightarrow K^+\pi^+\pi^-p$, $K^+ + p \rightarrow K^+\Pi^+\Pi^-p$ (π^0 unseen), $K^+p \rightarrow p\pi^+\pi^-\pi^+$ (K^0 unseen) $K^+p \rightarrow K^+\pi^+\pi^-\pi^+$ (n unseen), and $K^+p \rightarrow pK^+K^+K^+$ were uniquely identified from the analysis. (auth)

45652 COMPENSATION OF THE DRIFT OF CHARGED-PARTICLE TRACKS IN WIDE-GAP SPARK CHAMBERS. Avakyan, K. M.; Aivazyan, R. B.; Matevosyan, E. M. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 6, 1645-7(1971).

Translated from Prib. Tekh. Eksp.; 14: No. 6, 54-6(1971).

A method is described for supplying wide-gap spark chambers with high-voltage rf pulses. It is shown that for a sign-alternating field there is no displacement of the spark tracks relative to the true charged-particle trajectory due to drift of avalanches. A description is given of a generator which allows high-voltage rf pulses having a frequency of from 3 to 8 MHz to be obtained. (auth)

Radiometric Instruments

Refer also to abstracts: 45717 and 47267.

45653 (CSIRO-Trans-10705) CALIBRATION OF RADIOACTIVE LOGGING APPARATUS AND NEUTRON MODELING. Laszlo, Andrassy Translated by G. Losonci for Commonwealth Scientific and Industrial Research Organization, Australia, from Magy. Allami Eotvos Lorand Geofiz. Int. Evi Jelentese; 137-40 (1968). 2p. Dep. NTIS (U. S. Sales Only).

A calibration technique for the two-detector gamma-gamma logging method using a borehole model was developed and gave the advantage of optimal pressing onto the wall. Calibration measurements for epithermal neutrons in water (100%), oily sand (45%), limestone (0%) and a glass tube model (6%) are shown. (Australia)

45654 SYSTEM AND METHOD FOR FACILITATING THE OPERATING SETUP OF A RADIATION GAUGE. Doering, George I. (to Industrial Nucleonics Corp.). U. S. Patent 3,668,398. 6 Jun 1972. Filed 26 Dec 1968.

Disclosed are a system and method for facilitating the setup of a nucleonic gage and automatic controller for measuring and controlling the thickness of a material. The gage includes conventional calibration circuits having variable voltage dividers set in accordance with the expected operating points for the material thickness center scale and gage sensitivity. In one embodiment, the sensitivity and operating point voltage dividers as well as the automatic controller set-point voltage divider are set with the aid of an auxiliary bridge including additional voltage dividers ganged with the voltage dividers of the gage calibration circuits. In another embodiment, one of the auxiliary bridge voltage dividers has a logarithmic response, enabling calibration for different materials to be established by changing the input voltage to the auxiliary bridge. (auth)

45655 APPARATUS FOR MEASURING HEIGHT OF A MOLTEN METAL POOL. Blecherman, Sol S.; Ulion, Nicholas E.; Packer, Louis L. (to United Aircraft Corp.). U. S. Patent 3,668,386. 6 Jun 1972. Filed 13 Mar 1969.

An apparatus for detecting the liquid level in, or the liquid-solid interface at the bottom of, a pool of molten metal or alloy utilizing a radioactive isotope as a source of radiation and sensing the amount of radiation over or through the pool of metal and in which the melting is accomplished by an electron beam impinging on the pool surface is described. (auth)

45656 IMPROVEMENTS TO EQUIPMENTS FOR MEASURING THICKNESS BY BACKSCATTERING. Levenes, Guy (to Societe Industrielle de Combustible Nucleaire). French Patent 2,070,925. 23 Aug 1971. Filed 11 Dec 1969. (In French).

A probe intended to be used in conjunction with apparatus for measuring the thickness of thin films by β particle backscattering is presented. The system utilizes a radioactive source and a Geiger–Muller counter. The axis of the source, the axis of the G M counter, and the normal to the surface examined lie in the same plane. The angles formed between the axis of the source and the axis of the G M counter and the normal are made as small as possible and arranged to be on either side of the normal. A description is given of probes primarily intended to measure the thickness of thin films deposited inside tubes, or cavities having cylindrical or conic surfaces, or on large surfaces. (France)

45657 RADIOMETRIC UNIT FOR MEASURING WEAR OF MATERIALS AND MACHINE PARTS. Ivanov, E. A.; Magarik, K. N. Izotopy SSSR; No. 22, 29-31(1971). (In Russian).

A two-channel automatic device for studying resistance to wear of machine parts which is based on the radioindicator method is described. A two-component isotopic mixture consisted of ^{60}Co and ^{75}Se in lubricating oil. The ^{60}Co was used to label a cast iron cylinder sleeve and ^{75}Se, a chrome-plated piston ring of a Diesel engine. The merit of the system was demonstrated by its sensitivity ($\sim 2 \times 10^{-8}$ Ci/l), its reliability, and its ease of operation. The possibility of automatic measurement and recording of the spectra of a multi-component isotopic mixture is explored. (tr-auth)

45658 SEMICONDUCTOR WELL LOGGING PROBE. Andrieux, Claude; Dumesnil, Patrice; Javellaud, Jean (to Commissariat a l'Energie Atomique). French Patent 2,070,479. 16 Aug 1971. Filed 5 Dec 1969. (In French).

A probe was developed for radioactive well logging using high-resolution γ spectrometry. The probe contains an intrinsic semiconductor nuclear particle detector device, a liquified gas cryostat, a high voltage supply for the detector, and an appropriate preamplification device. The intrinsic semiconductor is made of Ge or Si in which the residual impurities are compensated by Li. This probe can be used to measure the ^{235}U content of ore. (France)

45659 RADIOACTIVE RADIATION-TYPE FLUID INTERFACE DETECTION SYSTEM. Bajek, Walter A.; Boyd, David M. Jr. (to Universal Oil Products Co.). U. S. Patent 3,668,392. 6 Jun 1972. Filed 20 May 1969.

Method and apparatus for locating one or more liquid–liquid interfaces within a closed vessel by utilizing a radiation-type interface detector are described. A traveling radiation source within the vessel and a traveling radiation detector outside the vessel, the paths of travel of both being vertical and the speed of both being synchronized, are used to provide constant path length between them. The instrument output is in the nature of a density profile. (5 figures) (auth)

Radiation Effects on Instrument Components, Instruments, and Electronic Systems

Refer also to abstracts: 45438, 45620, and 47230.

45660 (FRNC-CONF-29) NOISE IN Au–nSi DIODES OPERATING IN THE AVALANCHE REGION IN THE PRESENCE OF CHARGES INJECTED BY RADIATION. Peyre-Lavigne, A.; Cassanhiol, B.; Peyre-Lavigne, M. (Toulouse Univ. (France). Centre de Physique Atomique et Nucleaire). 1971. 15p. (In French). (CONF-710958-1). Dep. NTIS (U. S. Sales Only).

From International conference on the noise in active semiconductor devices; Toulouse, France (21 Sep 1971).

Results are given of measurements made on Au–nSi and Al–pSi diodes (with leakage current collection rings made by metallization under vacuum) when the avalanche potential is reached. A temperature of 300°C is not exceeded during their manufacture, thus conserving the lifetime of the minority carriers. Surfaces as large as 12 mm^2 were prepared, which did not exhibit microplasmas at avalanche potentials reaching 1800 volts. This fact is in good agreement with theoretical values obtained by Van Overstraeten. The maximum coefficient of amplification did not exceed 20. The diodes (metal-semiconductor) were used to establish a model taking into account the current from the metal-semiconductor contact and the channel, the latter being linked to the surface potential and the density of surface states characteristic of a given passivation. This model enables good agreement to be obtained between theory and experiment in the analysis of shot noise. A

method is given for analyzing shot noise produced by radiation penetrating a diode operating in the multiplication region. (France)

45661 (N-72-17158) EFFECTS OF 22-MeV PROTONS ON SINGLE-JUNCTION AND SILICON-CONTROLLED RECTIFIERS. Beatty III, Marvin E. (National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center). Feb 1972. 31p. (NASA-TN-D-6631). NTIS.

The effects of 22-MeV protons on various types of silicon single-junction and silicon-controlled rectifiers were investigated. The results show that low-leakage devices and silicon-controlled rectifiers are the most susceptible to radiation damage. There are also differences noted between single-junction rectifiers of the same type made by different manufacturers. This finding emphasizes the need for better selection of devices used in spacecraft. (auth) (STAR)

45662 (SC-DC-721232) DEVICE DEGRADATION FROM THE EFFECTS OF NUCLEAR RADIATION ON PASSIVATION MATERIALS. Coppage, F. N.; Graham, E. D. Jr. (Sandia Labs., Albuquerque, N. Mex.). Jul 1972. 19p. (CONF-720707-2). Dep. NTIS.

From Annual conference on nuclear and space radiation effects; Seattle, WA. (24 Jul 1972).

Bipolar transistors that utilized three different commercial passivation processes were studied in a nuclear radiation environment to determine if the passivation process influences the radiation tolerance of the device. Comparisons were made between devices obtained from the same manufacturer. The passivation processes studied featured silicon dioxide, silicon nitride, and aluminum oxide. Irradiations were performed with the devices in both a biased and unbiased mode. The results show that the device with silicon dioxide passivation degraded the most. The nitride devices having beam leads showed no saturation of the induced degradation while the other processes did for a dose of 1×10^7 (Si). All devices studied showed a small bias dependence. The addition of an aluminum oxide or silicon nitride passivation layer (over the silicon dioxide surface) for increased reliability definitely induces no increased radiation degradation. (auth)

45663 (SC-DC-721233) RADIATION EFFECTS IN MICROWAVE BIPOLAR TRANSISTORS. Graham, E. D. Jr.; Chaffin, R. J.; Gwyn, C. W. (Sandia Labs., Albuquerque, N. Mex.). [nd]. 11p. (CONF-720707-3). Dep. NTIS.

From Annual conference on nuclear and space radiation effects; Seattle, WA. (24 Jul 1972).

The effects of gamma and neutron radiation on the high frequency characteristics of microwave transistors (HP-35821E) are explored. From theoretical and experimental results, it is determined that the major effect is a decrease in the forward transfer coefficient (S_{21}) resulting from a neutron-enhanced decrease in cutoff frequency (f_t) (i.e., increase in emitter-to-collector transit time). For the recommended operating conditions (V_{CE} = 15V, I_C = 15 mA) no change in S-parameters was noted after 10^7 rads (Si) gamma. By increasing the collector voltage so that the epitaxial collector is entirely depleted, these devices can be operated at fluence levels of 8×10^{15} n/cm^2 (E > 10 keV, 14-Mev equivalent). (auth)

45664 (SC-DC-721237) CARRIER TRAPPING EFFECTS IN IRRADIATED PN JUNCTIONS. Gwyn, C. W. (Sandia Labs., Albuquerque, N. Mex.). [nd]. 25p. (CONF-720707-4). Dep. NTIS.

From Annual conference on nuclear and space radiation effects; Seattle, WA. (24 Jul 1972).

Numerical calculations have been used to study small signal trapping effects in neutron irradiated pn junctions as a function of frequency. Good agreement has been obtained between the calculations and experimental data in n-type silicon using two acceptor centers to model the trapping centers produced by neutron irradiation. A single level donor center has been used for p-type material. These calculations indicate that complex changes in the carrier distributions within the device can be responsible for a rather simple variation in the terminal characteristics of the device. Although good agreement has been obtained between the calculated and experimental results, the calculations suggest that another deep acceptor level (consisting of about 10% of the total trap density) may be present in n-type material which provides a more gradual change in the terminal capacitance with frequency than that noted using the two acceptor centers. (auth)

45665 (SC-DC-721240) RAPID ANNEALING OF FREQUENCY CHANGE IN CRYSTAL RESONATORS FOLLOWING PULSED X-IRRADIATION. King, J. C.; Sander, H. H. (Sandia Labs., Albuquerque, N. Mex.). Jul 1972. 34p. (CONF-720707-5). Dep. NTIS.

From Annual conference on nuclear and space radiation effects; Seattle, WA. (24 Jul 1972).

A transient negative frequency change in AT-cut 125 MHZ 5th overtone quartz resonators has been observed following exposure to an intense burst of x-rays. All natural, Z-growth synthetic and swept Z-growth synthetic resonators suffer a significant initial negative frequency offset. At room temperature, the transient frequency change in natural quartz anneals in approximately ten minutes to a relatively stable negative offset. For the synthetic quartz resonators, appreciable annealing of the initial negative offset continues for a longer period, finally arriving at an offset which is positive in the case of the Z-growth synthetic but negligibly small for swept Z-growth synthetic. The transient frequency change is attributed to a relaxation process which anneals above 165°K (Stage I). This annealable relaxation is superposed on a more stable part (Stage II) which is removed only by heating the crystal well above room temperature. The kinetics of Stage I annealing obeys a $t^{-\frac{1}{2}}$ relationship which is indicative of a three-dimensional diffusion limited annealing mechanism involving point defects. It is proposed that the transient change in frequency is due to the trapping of monovalent cations, most probably H^+, at substitutional aluminum sites in the crystal lattice. The activation energy governing the diffusion of the defect to the trapping center is estimated to be 0.80 ± 0.5 ev. (auth)

45666 (SC-RR-720515) SEMICONDUCTOR DEVICE DEGRADATION BY HIGH AMPLITUDE CURRENT PULSES. Brown, W. D. (Sandia Labs., Albuquerque, N. Mex.). Jul 1972. 34p. Dep. NTIS.

The results of a lengthy and comprehensive investigation of semiconductor device degradation from gamma-induced nanosecond current pulses are given. Topics discussed include (1) previously published literature on pulse degradation and second breakdown, (2) experimental results obtained in several studies, (3) pulse damage recovery using several annealing techniques, (4) a model of the pulse damage, (5) possible methods of hardening against pulse degradation, and (6) a preventive measure that can be taken to eliminate pulse damage. (auth)

45667 (SC-T-722519) EFFECT OF GAMMA RADIATION ON THE OSCILLATION FREQUENCY OF AT-CUT PIEZOQUARTZ PLATES. Starodubtsev, S. V.; Chubarov, L. B. Translated by Patricia Newman (Sandia Labs., Albuquerque, N. Mex.), from Dokl. Akad. Nauk Uzb. SSR; 24: No. 1, 22-3(1967). 3p. Dep. NTIS.

The change in oscillation frequency of AT-cut native quartz plates subjected to cobalt-60 gamma radiation at 10^9 to 10^{10} rad was studied. Various types of self-excited oscillators employing either tubes or semiconductor triodes were used to generate oscillations in the plates. The oscillation frequency was 2 to 4 MHz. The plates were irradiated up to 2×10^{10} rad with ^{60}Co gamma radiation at a dose rate of 600 to 400 rad/sec at 42 to 36°C and 15,000 rad/sec at 90 to 100°; and they were irradiated up to 10^9 rad at a dose rate of 90 rad/sec at 29°C and 250 rad/sec at 32°C. No significant changes were observed in the oscillation frequency of the plates. The measurement accuracy was 0.01%. (W.H.K.)

45668 (UCRL-73974) X-RAY-INDUCED PHOTOCONDUCTIVITY IN DIELECTRIC FILMS. Weingart, R. C.; Barlett, R. H.; Lee, R. S.; Hofer, W. (California Univ., Livermore. Lawrence Livermore Lab.). 16 Jun 1972. 55p. (CONF-720707-10). Dep. NTIS.

From Annual conference on nuclear and space radiation effects; Seattle, WA. (24 Jul 1972).

The conductivity induced in films of polyethylene, epoxy, polytetrafluoroethylene, polyethylene teraphthalate, polyimide, and glass by x rays at dose rates between 10^9 and 10^{10} rads/sec (dose in air) were measured. The films were 0.05 to 1.25 mm thick. The x-ray spectrum peaked in the vicinity of 10 keV, and the x-ray pulse width was about 40 nsec FWHM. X-ray-induced photocurrents were found to obey Ohm's law at low bias voltages (less than 1 kV). Above 1 kV, however, it was observed that the peak photoconductivity signals from some of the 0.05-mm-thick materials began to increase at a slightly faster than linear rate with bias voltage. The glass samples exhibited no apparent delayed conductivity, while the other sample materials showed various amounts. The magnitude of the delayed conductivity in polytetrafluoroethylene, polyethylene terephthalate, and polyimide depended on the electric field, an effect that is consistent with Poole-Frenkel field-assisted carrier generation. The magnitude and time dependence of the conductivity signals is quantitatively described by a simple trapping model using reasonable values for mobility, trap density, capture cross sections, and trap depths. (auth)

45669 EFFECT OF α PARTICLES ON THE OPERATING REGIME OF A CO_2 LASER. Popescu, Ion M. (Inst. of Atomic Physics, Bucharest); Preda, Alexandru M.; Enache, Ana. Rev. Roum. Phys.; 17: No. 2, 121-3(1972) (In French).

Experimental results from operating a CO_2 laser in the presence of an alpha source are presented. The laser supply voltage decreased, and the power output decreased due to a variation of the emission spectrum in the immediate region of the alpha particles emitted by the source. (tr-auth)

45670 EFFECTS OF X-RAY IRRADIATION ON MAS DIODES. Nakagiri, Masaru; Tsujide, Tohu (Nippon Electric Co., Ltd., Kawasaki, Japan). Jap. J. Appl. Phys.; 11: No. 7, 1054(Jul 1972).

The shifting characteristics of the flat band voltage of metal–Al_2O_3–Si (MAS) diodes from x-ray irradiation under a certain bias voltage (B–X treatments) are described. B–X treatments shift the flat band voltage of MAS diodes with irradiation time until it reaches a certain saturated value, depending on the bias voltage, after irradiation of 20 minutes. When a sequence of B–X treatments at various bias voltages is carried out, the magnitude of flat band voltage is determined by the bias voltage of the last B–X treatment. It is concluded that x-ray irradiation creates hot electrons in the Al_2O_3 film and metal electrode, those excited electrons are transported by the electric field, and the charge transport forms a space charge in the Al_2O_3 film and it continues until the space charge compensates the external electric field due to the bias voltage. (2 figures) (R.W.R.)

45671 EFFECTS OF IMPURITIES ON GAMMA-IRRADIATED SILICON CRYSTAL EXAMINED BY PHOTOVOLTAIC EFFECT OF P–N JUNCTION DIODE. Yamaguchi, Masafumi; Nagai, Osamu (Nippon Telegraph and Telephone Public Corp., Tokai, Japan). Jap. J. Appl. Phys.; 11: No. 7, 1016-23(Jul 1972).

Minority-carrier lifetime in ^{60}Co-gamma-irradiated silicon bulk crystals was examined by the photovoltaic effect of silicon p–n junctions, and following results were obtained. The damage constant, K, increases with impurity concentration of bulk crystals; K is smaller in p-type crystals than in n-type. For isochronal annealing, recovery stages of n-type bulk crystals at 100 to 150°C and 300°C are found; in p-type crystals, reverse annealing is observed at 200 to 300°C. From the temperature dependence of carrier lifetime, energy levels of the recombination centers at E_c – 0.42 eV for n-type and E_v + 0.32 and E_v + 0.25 eV for p-type crystals are found. Recovery stage of p-type bulk crystals due to gamma irradiation at 81 K is observed at about 150 K, but that of n-type is not observed between 80 and 300 K. The lifetime degradation in p-type crystals due to gamma irradiation at 81 K is reduced when the minority carrier is injected after the irradiation. (13 figures, 2 tables) (auth)

45672 RADIATION-RESISTANT PLASTIC INSULATORS. Sturm, Bernard J.; Parkinson, William W. (to United States Atomic Energy Commission). U. S. Patent 3,663,504. 16 May 1972. Filed 10 Nov 1970.

A high molecular weight organic composition useful as an electric insulator in radiation fields is provided and comprises normally a solid polymer of an organic compound having a specific resistance greater than 10^{19} ohm cm and containing phenyl groups and 1 to 7.5 weight percent of a high molecular weight organic phosphite. In one embodiment the composition comprises normally solid polystyrene having 7.5 weight percent tris-β-chloroethyl phosphite as an additive; the composition exhibited an increase in the post-irradiation resistivity of over an order of magnitude over the post-irradiation resistivity of pure polystyrene. The plastic was developed for use in pocket ionization monitors. (auth)

Miscellaneous Instruments and Components

Refer also to abstracts: 45243, 46093, and 47317.

45673 (UCRL–50007-71-3) HAZARDS CONTROL. Progress Report No. 41, September–December 1971. (California Univ., Livermore. Lawrence Livermore Lab.). 22 Mar 1972. Contract W-7405-eng-48. 27p. Dep. NTIS.

ATMOSPHERE—particle diffusion in, zinc sulfide tracer detector for measuring, pp. 1,2
FILTERS—performance testing of high efficiency air, pp. 11-13
LIVERMORE POOL TYPE REACTOR—operation and repair of, Sept.–Dec., 1971, pp. 14-16
PLUTONIUM-239—determination in waste drums, development of NaI(Tl) scanning system for, pp. 4-6
RAD DOS, THERMOLUMINESCENT—sensitivity to fluorescent and ultraviolet light, pp. 13,14
RESPIRATION—simulation of human, calibration and performance of mechanical apparatus for, pp. 7-11
RESPIRATORS—efficiency of cartridges for, effects of steady state and pulsating flow on, pp. 7
SOILS—radioactivity in, coring sampler for depth profile measurements of, pp. 18-19
VENTILATION—system at LLL, fire protection for, pp.16,17
X-RAY SOURCES—development of tube, for fluorescence analysis of trace elements, pp. 2,3 (C.E.S.)

45674 (UCRL–73665) REVIEW OF PROBLEMS ASSOCIATED WITH ACCELERATION MEASUREMENTS. MacLean, Lee M. (California Univ., Livermore. Lawrence Livermore Lab.). 15 May 1972. 12p. (CONF-720312–11). Dep. NTIS.

From Underground nuclear test measurement symposium II; Menlo Park, CA. (21 Mar 1972).

A review of the past four years of acceleration measurements in underground nuclear test environments points out the excessively high percentage of "lost" data channels. Typical data traces from underground nuclear tests and high-explosive simulation tests illustrate a chronological review of problems associated with acceleration measurements. Various design philosophies have evolved to circumvent certain problems. Areas of concern include instrument-cable EMP, poor mount design, sensitive components of accelerometers, low resonant frequencies, and undamped response of accelerometers. As a result of this evaluation of typical recorded data, the validity of most underground accelerometer data is challenged. (14 figures, 1 table) (auth)

45675 CIRCUIT FOR CONTINUOUS ACQUISITION OF RATE RATIO OF TWO PULSE TRAINS. Seda, Josef; Sabol, Jozef (Technical Univ., Prague). Jad. Energ.; 18: No. 5, 163-6(May 1972). (In Czech).

The problem of continuously dividing two signals, represented by two pulse trains, is considered. Some known ratio circuits are briefly discussed, and their advantages and disadvantages are pointed out. A new improved (especially as to the reliability and linearity of result with respect to the ratio of input signals) ratio circuit is designed. At its output there is available an analog or digital signal which is proportional to the ratio of the signals applied to the input. In addition to the block diagram of the ratio circuit, practical design using integrated circuits is also presented. Moreover, the possible application of the proposed circuit for the processing of signals from an ionizing radiation detector is examined. (7 figures) (auth)

45676 SHAPE OF THE MASS PEAK IN A THREE-DIMENSIONAL QUADRUPOLE MASS SPECTROMETER. Sheretov, E. P.; Zenkin, V. A. (Ryazan Radio Engineering Inst., USSR). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 1, 160-2(Jul 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 1, 199-202(Jan 1972).

Calculations of the shape of the mass peak in a three-dimensional quadrupole mass spectrometer are reported for various conditions for the introduction of the ionizing electron beam. It is shown that, as these conditions change, there is a change in the shape of the mass peak and in the position of the maximum-sensitivity line on the stability diagram. The shape is calculated for the phase method for introducing the electron beam. The calculated results are confirmed by experiment. (3 figures) (auth)

45677 NUCLEAR CHARGED SELF-SUSTAINING LASER. Morrison, Clyde A.; Wortman, Donald E.; Farrar, Ruben T. (to Secretary of the Army). U. S. Patent 3,667,068. 30 May 1972. Filed 17 Aug 1970.

A nuclear-charged solid-state laser which requires no external power supply is described. A large class of single crystals which contain a stable isotope that is potentially radioactive is disclosed. The crystal is doped with a laser impurity ion and is irradiated with nuclear energy such that the stable isotope becomes radioactive to provide a pumping source for the laser impurity ions therein. Optical resonator means can be provided by coating both ends of the crystal with highly reflective surfaces. The radioactive isotope provides a continuous internal power supply over the lifetime of its decay, and thus provides a potentially compact, portable, and inexpensive solid-state laser device. (2 figures) (auth)

45678 INVESTIGATION OF THE INJECTION CHARACTERISTICS OF SYMMETRICAL PIN-DIODES PREPARED BY THE METHOD OF ION IMPLANTAION. Akimov, Yu. S.; Gusev, V. M.; Kurinnyi, V. I.; Ryzhikov, I. V. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 16: No. 10, 1714-22(Oct 1971).

Translated from Radiotekh. Elektron.; 16: No. 10, 1917-26 (Oct 1971).

A survey of the basic drift and diffusion theories of double injection relative to symmetrical PIN structures with different width of the I region (W/L_p = 0.3 – 15) is presented. Precise knowledge of the parameters of the individual regions of the P^+PN^+ structures, prepared by ion alloying of plates of high-ohmic p-silicon, permitted carrying out both a detailed qualitative and a detailed quantitative comparison of the experimental characteristics with

the theories predicted by drift and, in essence by diffusion double injection. The insufficiency of the diffusion model of Hall in analyzing the long PIN structures is shown and the Kleinman segment of the volt–ampere characteristics was investigated in detail. By quantitative comparison of experiment and theory, the influence of the nonuniform distribution of the impurity in the highly alloyed layers was accounted for. In the long diodes ($W/L_p > 2$) the drift segment of the volt–ampere characteristics of Rashba–Tolpygo–Lampert–Rose that preceded the diffusion segment was detected and investigated. (auth)

45679 REMOVABLE CURRENT LEAD FOR POWER SUPPLY IN SUPERCONDUCTING MAGNETIC SYSTEMS. Anashkin, O. P.; Kurnosova, L. V.; Razorenov, L. A.; Sidyakina, T. M.; Fradkin, M. I. (Inst. of Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1230-1(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 233-4(Jul-Aug 1971).

The construction of a removable current lead for power supply in short-circuited superconducting magnetic systems is described. The use of a removable current lead in equipment designed for operation on board an artificial earth satellite ensures reliable operation of the magnetic system in the short-circuit mode and allows a substantial reduction of the overall heat influx to the helium. (1 figure) (auth)

45680 INTRODUCTION OF CORRECTION FOR THE NONLINEARITY OF A DIRECT-CURRENT Q-METER. Kovalev, A. I.; Shklyarevskii, V. M. (Physical-Technical Inst., Leningrad). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1142-4(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 165-7(Jul-Aug 1971).

The corrections for the nonlinearity of a direct-current Q-meter are calculated by means of the exact formula for the impedance of the measurement tank circuit. (2 figures, 1 table) (auth)

45681 USE OF THE ADMISSION SYSTEM OF THE MI-1309 INSTRUMENT FOR PRECISION ISOTOPIC ANALYSIS. Golubchina, M. N.; Prilutskii, R. E.; Toksubaev, A. I. (All-Union Scientific-Research Geological Inst., Leningrad). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1148-51(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 170-2(Jul-Aug 1971).

A study was made of the fractionation of isotopes when gaseous substances are introduced into a mass spectrometer using an admission system typical of instruments belonging to a unified series. It was shown experimentally that the greatest distortion of the isotope composition occurs in the ampule–container section and is associated with the inlet of gas into the container through a shutoff valve. Discrete admission of the sample is suggested. It is likewise shown that the difference between the intensities of the sample and standard gas flows has no effect on the results of the analysis within the limits ±9%. (4 figures, 2 tables) (auth)

45682 SOME COMMENTS ON THE SIGNAL-TO-NOISE CHARACTERISTICS OF REAL PHOTOMULTIPLIER AND PHOTODIODE DETECTION SYSTEMS. Santini, R. E. (Purdue Univ., Lafayette, Ind.); Ingle, J. D. Jr.; Crouch, S. R. Anal. Chem.; 44: No. 9, 1708-11(Aug 1972).

Comments are made by R. E. Santini on a previous paper (J. D. Ingle and S. R. Crouch, Anal. Chem., Vol. 43, p. 1331) in which a comparison was made between the signal-to-noise characteristics of a high-gain photomultiplier and a photodiode when the overall gain of the total system including the amplifiers was the same. Additional variables which were not considered in the previous paper are presented and briefly discussed. Also, J. D. Ingle and S. R. Crouch reply to Santini's comments. (W.H.K.)

45683 MOESSBAUER DIFFRACTOMETER HAVING HIGH ANGULAR RESOLUTION. Artem'ev, A. N.; Aleshin, K. P.; Mirzababaev, R. M.; (and others) (Inst. of Atomic Energy, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 6, 1656-8 (1971).

Translated from Prib. Tekh. Eksp.; 14: No. 6, 64-6(1971).

A Moessbauer diffractometer is described which allows measurement of the diffraction spectra of single crystals in a one- or two-crystal spectrometer with an x-ray tube or Moessbauer source. The x-ray crystal-monochromator and the γ-ray crystal-collimator, which are situated at a stipulated angle, allow alignment of the working crystal by an x-ray beam to be used in making the transition to operation with γ radiation. Measurement of the angular dependences may be carried out either automatically with a step $\geq 10''$, or manually with a step $\geq 0.5''$. The constant velocity of the Moessbauer source is used in the installation to carry out angular measurements and to perform motion with a constant acceleration; a multichannel analyzer is used to measure the Moessbauer spectra at constant diffraction angles. (auth)

45684 CALCULATION OF THE DEAD TIME OF HIGH-SPEED AMPLITUDE CONVERTERS. Glushkovskii, M. E. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 6, 1671-5 (1971).

Translated from Prib. Tekh. Eksp.; 14: No. 6, 78-82(1971).

A procedure is described for the engineering calculation of the dead time and the determination of the counting characteristics of high-speed amplitude converters which operate according to the methods of weighting, A–t code conversion, and accelerating A–T code conversion. The dependences on the shape of the spectrum, the shape of the input pulses, the conversion method, the ratio between the conversion and recording times, and the input loading are considered. The shape of the spectrum is assumed to be exponential. An example is given of determining the counting characteristic of the BAP-6M converter combined with an AI-1024-4 recorder. (auth)

45685 AVERAGE-PULSE-AMPLITUDE METER. Selyutin, V. P. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 6, 1693-4(1971).

Translated from Prib. Tekh. Eksp.; 14: No. 6, 96-8(1971).

A network is described that allows measurement of the average value of a pulse amplitude with an accuracy ~0.5% which is achieved by using a control switch in the discharge circuit of the integrating cell. The network was used in investigating the efficiency of charge collection from semiconductor nuclear-particle detectors. (auth)

45686 COMPUTER SYSTEMS FOR PHYSICS RESEARCH CENTERS (REVIEW). Zabiyakin, G. I.; Polyakov, V. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 6, 1593-1606(1971).

Translated from Prib. Tekh. Eksp.; 14: No. 6, 5-19(1971).

The premises underlying the creation of multimachine systems of electronic computers in physics research centers and the principal features of designing such systems for the purpose of handling experimental data in real time are considered. (79 references) (auth)

45687 ELECTRICAL INSULATION IN ELECTROSTATIC ANALYZERS (REVIEW). Ergakov, V. A.; Kryuchkov, I. I.; Trebukhovskii, Yu. V. (Inst. of Theoretical and Experimental Physics, M Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 6, 1607-18(1971).

Translated from Prib. Tekh. Eksp.; 14: No. 6, 20-31(1971).

The selection of the type of residual gas and its pressure, as well as the electrode material, in order to achieve the maximum electric field intensity in an interelectrode gap of 2 to 20 cm is considered for electrostatic analyzers having plane-parallel electrodes in a vacuum. Problems associated with the choice of insulator material and measures for equalizing the voltage along the insulator are discussed. Construction versions of the high-voltage input leads (for voltages up to 1 MV) into the vacuum chamber are presented. (36 references) (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstracts: 45289 and 47300.

45688 (MLM–1936(TR)) SEPARATION OF SULFUR ISOTOPES BY A CHEMICAL EXCHANGE METHOD. Egiazarov, A. S.; Kaviladze, M. Sh.; Kerner, M. N.; Oziashvili, E. L.; Esakiya, K. E. Translated for Mound Lab., Miamisburg, Ohio, from Isotopenpraxis; 7: No. 9, 379-83(1971). 15p. Dep. NTIS.

A comparison of methods for separating sulfur isotopes to obtain large quantities of highly concentrated sulfur isotopes showed that the most promising one is a chemical exchange method in a sulfur dioxide–bisulfite ion system. However, results obtained by various authors on the values of the elementary separation coefficient and on other parameters of the process are conflicting and inadequate for carrying out the technological process. The elementary separation coefficient, α, was determined by a method for the one-step equilibration of sulfur isotopes at temperatures of 25, 50, and 70°C and on a column with a known efficiency for isotopes $^{32}S/^{33}S$ and $^{32}S/^{36}S$ at a temperature of 70°C. (auth)

45689 (ORO–694) REPORT OF URANIUM ISOTOPE SEPARATION REVIEW AD HOC COMMITTEE. Benedict, Manson; Berman, Abraham S.; Bigeleisen, Jacob; Powell, Jack E.; Shacter, John; Vanstrum, Paul R. (Oak Ridge Operations Office (AEC), Tenn.). 2 Jun 1972. 68p. Dep. NTIS.

Results of committee efforts to evaluate the potential of uranium isotope separation methods other than gaseous diffusion and the gas centrifuge and to determine whether any other processes warrant AEC research and development are presented. It was concluded that many of the processes have such major qualitative disadvantages relative to gaseous diffusion that quantitative evaluation of their principal characteristics is not warranted. For a limited number of the relatively more promising processes, however, quantitative assessment has been made of appropriate process characteristics, to facilitate comparison with the gaseous diffusion process. This comparison is summarized and tabulated. For most of the processes, it has been possible either to estimate a separation factor or to set an upper bound for it. The number of stages or transfer units needed for a given degree of separation is inversely proportional to the separation factor tabulated, $\alpha - 1$. Of all the processes considered, only the Becker separation nozzle process has a higher separation factor than gaseous diffusion. Liquid-liquid chemical exchange between $NOUF_6$ and UF_6 has the highest separation factor of all the potentially reversible processes examined. The magnitude of the separation factor is at best only suggestive of the relative merit of a process. Indexes more directly related to the cost of separative work are the specific energy consumption, the specific uranium inventory, and the unit capital cost. (J.R.D.)

45690 DEUTERIUM SEPARATION PROCESS. Clarke, E. C. W.; Glew, D. N. (to Dow Chemical Co.). Canadian Patent 893,684. 22 Feb 1972.

A liquid mixture of hydrogen and deuterium sulfides is distilled at a pressure of from about 30 to about 1,300 psia and a temperature of from about −45 to about 100°C, and the gaseous deuterium sulfide-enriched overheads are collected. Refluxing or recycling steps can be incorporated in the process. The enriched distillate can subsequently be processed to yield deuterium oxide. (Canada)

45691 URANIUM ISOTOPE SEPARATION STUDIES IN FRANCE. Lebrun, C. (Societe de Construction d'une Usine de Separation Isotopique, Le Plessis, France); Mezin, M. Energ. Nucl. (Paris); 14: No. 1, 5-16(1972). (In French).

The construction and operation of the Pierrelatte enrichment plant represents an important part of the program undertaken by France to meet the enriched uranium requirements of nuclear power reactors. An R and D program was completed on the well established gaseous diffusion technique. Results of basic economic studies indicate that this is the only method certain of fulfilling the enrichment requirements of the end of the present decade, which necessitate, in the western world, a construction rate capable of providing between 6 and 10 SWU/Y. These facts have led to the study of a gaseous diffusion production plant able to produce between 6 and 10 SWU/Y. The final plans will be ready in 1973. Other methods are also being reviewed; the most economic will be chosen for subsequent plants. (France)

45692 PROCESS AND DEVICE FOR THE SEPARATION OF MOLECULES OF DIFFERENT MASSES. Campargue, R. (to Commissariat a l'Energie Atomique). Canadian Patent 895,492. 14 Mar 1972

A process for the separation of molecules of different masses in a gaseous mixture is described. The mixture is circulated within a casing, into which an auxiliary gas jet is introduced at a supersonic velocity, creating a closed shock structure. The gas which is extracted from the interior of the shock structure contains a fraction of the mixture having a high concentration of light molecules, and the gas extracted from the outside of the shock structure has a low concentration of light molecules. The gaseous mixture to be processed can contain molecules of a different nature, isotopes of the same simple element (for example argon or hydrogen), or isotopic varieties of the same substance (for example hexafluorides of uranium-235 and uranium-238). (Canada)

45693 EVALUATE EUROPEAN SITING FOR NEXT ENRICHMENT PLANT. Grenon, Michel. Power Eng.; 76: No. 7, 35-7 (Jul 1972).

In Feb. 1972 an organization of six member nations, Belgium, France, Italy, Netherlands, UK, and West Germany, was formed to study the possibilities of building an international civilian gaseous diffusion plant in Europe. The experience of each country in separation work, the schedule for making decisions about the combined effort, and details on the design and performance of the French gaseous diffusion plant at Pierrelatte which has been operating for eight years are presented. (L.C.L.)

45694 ISOTOPE SEPARATION RATE IN HAEFFNER EFFECT. Sinha, Om P. (Simon Fraser Univ., Burnaby, B. C.). Appl. Phys. Lett.; 21: No. 1, 14-15(1 Jul 1972).

A simple theory is presented for Haeffner effect based on the ideas of Fiks. An exact formula derived for the isotope separation rate appears to be in good agreement with the experimental data on several systems. (auth)

45695 BRUCE AUXILIARY STEAM SUPPLY. Kolisnyk, Z. (Montreal Engineering Co. Ltd.): Spray, P. H. G. Eng. J. (Montreal): 55: No. 4, 22-6(Apr 1972).

An auxiliary steam plant for the Bruce Heavy Water Plant near Douglas Point, Ontario is nearly completed, and will produce 2.4 million lb/hr of steam at 180 lb/in^2 gage (360°F). The Bruce Heavy Water Plant, which will use the GS H_2O/H_2S exchange process to produce 30 to 45% D_2O (followed by distillation), could be run on the entire steam output of Douglas Point Generating Station, but then 220 MW of electrical energy would be lost. After 1977, Bruce Nuclear Generating Station will supply most of the steam required, but the auxiliary supply will still be useful. The auxiliary plant will burn Bunker C residual oil supplied by unit train. Because of the danger of leakage of corrosive hydrogen sulphide into the three boilers, steam will be generated at 600 lb/in^2 gage, and the lower pressure steam generated from this primary steam in four reboilers. No power will be generated. The design is compared with that of a similar plant at Point Tupper, Nova Scotia. (auth) (Canada)

45696 ISOTOPIC ENRICHMENT OF HYDROGEN FOR HEAVY WATER PRODUCTION. Lambert, Irma; Ravoire, Jean; Roth, Etienne (to Commissariat a l'Energie Atomique). French Patent 2,079,708. 18 Oct 1971. Filed 10 Feb 1970. (In French).

A method is presented for the isotopic enrichment of hydrogen in heavy water production by isotopic exchange between the hydrogen and a primary or secondary aliphatic amine in the presence of a catalyst. A tertiary amine having an RR'R''N form (R,R' and R'' = aliphatic radicals containing 1 to 4 carbon atoms) was added to the system. Trimethylamine and triethylamine were used in particular. (France)

45697 ULTRACENTRIFUGE ROTOR. Poubeau, Pierre (to Societe Nationale Industrielle Aerospatiale). French Patent 2,082,274. 15 Nov 1971. Filed 9 Mar 1970. (In French).

An ultracentrifuge for separating isotopic fluid elements is described that consists of a cylindrical vessel containing a radial vane system about a control axis. The radius of curvature of the sectors between consecutive vanes is greater than the outer radius of the vanes. Under the effect of the centrifugal rotation force, the radius of curvature of these sectors tends to approach the outer radius of the vanes. In this way the propeller-vane-wall system is given great rigidity. (France)

45698 VERSATILE HEAVY WATER. Swaroop, Janardhan (Bhabha Atomic Research Centre, Bombay). Vaigyanik; 3: No. 1, 8-12(Mar 1971). (In Hindi).

The importance of heavy water (D_2O) in the nuclear industry as a moderator to control the chain reaction in a reactor is discussed. Its physical and chemical properties, which distinguish it from ordinary water are outlined. Heavy water production

methods such as electrolysis of water, isotopic exchange process, partial distillation of water, low-temperature distillation, and hydrogen sulfide-ammonia dual temperature process are briefly described. Uses of heavy water in fields other than nuclear industry are enumerated. Experimental results of studies on the effects of heavy water on living organisms are also briefly described. (INIS)

Isotopic Power Sources

Refer also to abstract: 45677.

45699 (CEA-CONF-1998) RADIOISOTOPIC PACEMAKER DEVELOPMENTS IN FRANCE. Laurens, P.; Alais, M.; Berger, R.; Boucher, R.; Hixson, J. D.; Piwnica, A. [nd]. 30p. (CONF-711008-5). Dep. NTIS (U. S. Sales Only).

From nineteenth conference on remote systems technology; Miami Beach, Fla. (17 Oct 1971).

A review of the French program for development of nuclear-powered cardiac pacemakers is presented. Developments in this program are described in a presentation supported by a series of slides. (J.R.D.)

45700 (COO-2155-4) BIOMEDICAL ENGINEERING SUPPORT. Progress Report. Kolff, W. J.; Donovan, F. M. Jr. (Utah Univ., Salt Lake City (USA). Dept. of Surgery). 15 Apr 1972. Contract AT(11-1)-2155. 42p. Dep. NTIS.

Results of research on power requirements for artificial hearts for humans, efficiencies of artificial hearts, and aspects of mating these hearts to nuclear power sources are reported. One animal experiment is described in which a Kwan-Gett heart made of silastic was implanted in a bovine calf. (J.R.D.)

45701 (DP-1300) SAVANNAH RIVER LABORATORY ^{60}Co POWER AND HEAT SOURCES. Quarterly Progress Report, January-March 1972. Angerman, C. L. (comp.) (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). May 1972. Contract AT(07-2)-1. 19p. Dep. NTIS.

Galvanic corrosion on Inconel 600, nickel-plated cobalt metal, and couples between cobalt metal and superalloys during 61 days exposure to sea water; negligible corrosion occurred on the other superalloys and the ceramic cobalt compounds. None of the materials corroded significantly when exposed to bottom mud. Results of preliminary oxidation tests of iridium confirm data reported in the literature and indicate that a secondary capsule of an oxidation resistant material will be required to ensure containment of cobalt under accident conditions. Inactive superalloy capsules being heated at 850 to 1000°C are intact and performing satisfactorily after 39,400 h (4.5 yr). Fabrication of iridium capsules for ceramic cobalt compounds was begun; initial tests showed that sound welds could be made by TIG welding. The Hastelloy X being used to fabricate the fuel capsules and fuel pins for the WANL heat source exhibited satisfactory oxidation resistance during 5000-h tests at 1000°C; the Nickel 201 being used to fabricate the core also exhibited satisfactory resistance in 500-h tests at 1000 and 1125°C. The thermoelectric generator fueled with ^{60}Co continued to operate satisfactorily after 13 months with an electrical output of 58.5 W. (auth)

45702 (LA-4978) SPACE ELECTRIC POWER R AND D PROGRAM. Quarterly Report for the Period Ending April 30, 1972. (Los Alamos Scientific Lab., N. Mex.). Jun 1972. Contract W-7405-eng-36. 15p. Dep. NTIS.

Ceramic-metal multilayers containing Y_2O_3 as the electrical insulator were fabricated by arc-plasma-spraying Y_2O_3 onto metal collectors, followed by isostatic pressing of the trilayer assembly. Some properties of sprayed Y_2O_3 before and after isostatic pressing were determined. Arc-plasma-spraying of Y_2O_3 results in a dense, small-grained ceramic of low porosity after isostatic pressing at 10,000 psi and 1550°C. The electrical resistivity of a Nb-1% Zr/Y_2O_3 trilayer was accurately measured, and long-term tests at temperature are in progress. The post-irradiation inspection and evaluations of alumina specimens irradiated by Oak Ridge National Laboratory in Capsule ORNL EB-2 are nearing completion. Volume expansions of Lucalox, Coors AD-995, and WESGO Al-995 were determined. The swelling of Lucalox was generally less than previously observed for similar material. The Coors AD-995 swelled considerably more than Lucalox and was very fragile; and the WESGO Al-995 swelled more than either of the other materials and more than previously observed for similar material. Results of leak tests indicated very low probability that cylindrical shells will retain vacuum integrity if radioinduced swelling exceeds 3 vol %. An isothermal irradiator test unit was constructed which duplicates cooling conditions in the Experimental Breeder Reactor (EBR-II) better than has been possible in the past. Initial tests of the prototype heat pipe for Isothermal Irradiator K-5 were completed. Results of force-deflection measurements on ceramic bodies indicate decreases in moduli of elasticity and rupture of about a factor of two for irradiated alumina with a volume swelling of 3% compared to unirradiated material. No apparent decreases in these moduli due to irradiation were noted for Y_2O_3 for neutron fluences of $\sim 4.5 \times 10^{21}$ n/cm^2. Data on thermal diffusivity of one specimen of irradiated AD-999A alumina indicate no change due to irradiation at specimen temperatures above 500°C. A fracture sample of the tungsten cladding from General Electric Thermionic Test Assembly SCIP-518 was examined using a scanning-electron microscope. Numerous voids (0.2 to 2.5 μm dia) were detected in the cladding near the fuel/cladding interface. These voids decrease rapidly in size and number with increasing distance from this interface; they occur predominantly on grain-boundary surfaces. The locations of the voids could not be correlated with the locations of fission products detected at the fuel/cladding interface. (auth)

45703 (ORNL-4796) ORNL ISOTOPIC POWER FUELS QUARTERLY REPORT FOR PERIOD ENDING MARCH 31, 1972. Lamb, Eugene; Donnelly, R. G. (Oak Ridge National Lab., Tenn.). Jun 1972. Contract W-7405-eng-26. 38p. Dep. NTIS.

A vacuum hot-press for pressing pellets up to 1-in. diameter was assembled and tested. A process and the necessary hot-cell equipment to make ~250-μm-dia $^{244}Cm_2O_3$ microparticles have been developed. These particles are strong enough to be blended with metal powder to form cermets. The curium source test is being disassembled and the equipment salvaged. Causes of the transfer of curium fuel from the pellet channels to the upper interior sections of the capsule have been analyzed. Four samples of the curium fuel were taken during the disassembly for spark source mass spectrometry, x-ray diffraction, and helium release analyses. Two cylindrical $SrTiO_3$ pellets and four spherical Gd_2O_3 pellets were used to test the operation of the impact test unit. Three sabot heaters have been designed to heat the specimens to their expected operating temperature before impacting them. Construction of the laser system for velocity measurement is expected to be completed in April. The Pt-Rh-W alloys were found to be relatively insensitive to atmosphere contaminants such as those found in radioisotope thermoelectric generators. Hemispheres of Pt-26% Rh-8% W and Pt-30% Rh-8% W-0.25% Hf-0.1% Ti have been successfully fabricated. Iridium has been zone refined into single-crystal bar, which can be cold swaged 40% without cracking. Much higher oxygen levels can be tolerated by T-111 without embrittlement at temperatures higher than present Pioneer operating temperatures. T-111 embrittled by oxygen contaminants at 825°C can be ductilized by a heat pulse equivalent to that received by a Pioneer heat source upon reentry into the earth's atmosphere. Molybdenum alloys and coatings on T-111 continue to show relative insensitivity to contaminating environments. (auth)

45704 NEUTRON RADIATION CHARACTERISTICS OF PLUTONIUM DIOXIDE FUEL. Taherzadeh, Mojtaba (Jet Propulsion Lab, Pasadena, Calif.); Gingo, Peter J. Nucl. Technol.; 15: No. 3, 396-410(Sep 1972).

The major sources of neutrons from plutonium dioxide nuclear fuel are considered in detail. These sources include spontaneous fission of several of the Pu isotopes, (α,n) reactions with low Z impurities in the fuel, and (α,n) reactions with ^{18}O. For spontaneous fission neutrons a value of $(1.95 \pm .07) \times 10^3$ n/sec/gm PuO_2 is used. The neutron yield from (α,n) reactions with oxygen is calculated by integrating the reaction rate equation over all α-particle energies and all center of mass angles. The results indicate a neutron emission rate of $(1.14 \pm .26) \times 10^4$ n/sec/gm PuO_2. The neutron yield from (α,n) reactions with low Z impurities in the fuel is presented in tabular form for one part per million of each impurity. The total neutron yield due to the combined effects of all the impurities depends upon the fractional weight concentration of each impurity. The total neutron flux emitted from a particular fuel geometry is estimated by adding the neutron yield due to the induced fission to the other neutron sources. 22 references. (auth)

45705 RESULTS OF AN ENQUIRY INTO THE SOURCE REQUIREMENTS OF RADIOISOTOPE GENERATORS IN THE ENEA MEMBER COUNTRIES FOR 1971 TO 1975. Boutaine, M. (CEN de Saclay, Gif-sur-Yvette, France). Bull. Inform. Generateurs Isotop.; No. 11, 3-7(Dec 1971). (In French).

This study indicated that the largest and most probable demands will be for sealed ^{238}Pu and ^{90}Sr sources, and that the demands envisaged in 1971 are not very realistic when the current development in techniques is taken into consideration. The results obtained were analyzed. The following sources are considered: sealed sources for use in thermoelectric, ionic or dynamic conversion; α or β emitting sources for use in radiovoltaic conversion; and radioelements in the crude form for use in energy conversion. (France)

45706 FRENCH PROGRAM ON THE PRODUCTION AND USES OF ^{238}Pu. Berger, R.; Boucher, R.; Derian, J. C. (CEN, Fontenay-aux-Roses, France). Bull. Inform. Generateurs Isotop.; No. 11, 8-36(Dec 1971). (In French).

The studies undertaken in France on the production of ^{238}Pu are presented. The preparation of ^{237}Np and ^{241}Am based targets, the irradiation conditions and the chemical processing are described. Studies relating to the medical applications of ^{238}Pu are reviewed, in particular those concerning intracorporeal cardiac pacemakers and artificial intracorporeal hearts. The Delphi inquiry demonstrates that French cardiologists and specialists consider the artificial heart as a realistic objective, and expect that more widespread applications of such techniques will take place during the coming decade. (France)

45707 PROCESS OF FORMING AN ISOTOPIC HEAT SOURCE. Sump, Kenneth R.; Robinson, Ramon K.; Howard, Boyd D.; Drumheller, Kirk (to United States Atomic Energy Commission). U. S. Patent 3,666,846. 30 May 1972. Filed 11 Apr 1969.

A process of encapsulating an alpha-emitting isotope to form an isotopic heat source is described. Microspheres are prepared, each containing its own helium gas plenum, an alpha-emitting isotope, and containment cladding. These microspheres are sealed in a capsule with or without a metal matrix. (Official Gazette)

45708 RADIOISOTOPIC FUEL CAPSULE. Selle, James E.; Kokenge, Bernard R. (to United States Atomic Energy Commission). U. S. Patent 3,659,107. 25 Apr 1972. Filed 29 Jul 1970.

The design of a radioisotopic fuel capsule for use in thermoelectric or thermionic generators which utilizes substoichiometric plutonium dioxide enclosed within a refractory container is described. (Official Gazette)

Radiation Sources

Refer also to abstracts: 45432, 45446–45448, 45467, 45471, 45473, 45555, 45942, and 46008.

45709 (INIS-mf-256) RADIOISOTOPES, RADIOACTIVE PHARMACEUTICALS, RADIOACTIVE CHEMICALS, RADIOACTIVE SOURCES, SERVICES. (Institutt for Atomenergi, Kjeller (Norway)). 1972. 40p. INIS.

Specifications, prices and delivery times for eighty-eight radioactive pharmaceuticals and chemicals produced by Institute for Atomic Energy are given. ^{60}Co, ^{192}Ir and ^{198}Au sources for laboratory and industrial use and a variety of beta and gamma sources for training and demonstration purposes are described and prices given. Irradiation services are also available and containers, flux, etc. are specified. Standardized sources and solutions and absolutely standardized solutions are also available. The Institute also offers services in activation analysis and in the industrial applications of radioisotopes. (auth)

45710 USE OF RADIONUCLIDES FOR MEASUREMENTS IN MECHANICAL ENGINEERING, A FIELD OF WORK IN THE LABORATORY FOR ISOTOPE TECHNOLOGY. Gerve, A. (Gesellschaft fuer Kernforschung, Karlsruhe, Ger.). Kerntechnik; 14: No. 5, 201-4(May 1972). (In German and English).

On Jan. 1, 1971, the Laboratory for Isotope Technology was extended by the creation of the Department for Physics in Mechanical Engineering. The work of this new Department is subdivided into basic work for the further development of isotope technology, application experiments for research problems in the field of mechanical engineering, and work on industrial contracts which can now also be carried out based on requests of the customers with the aid of a mobile measuring unit. The work is concerned mainly with activation techniques, wear investigations, and the use of computers for automating experiment control. (auth)

45711 IMPORTANT WEAR MEASURING METHODS USING RADIONUCLIDES. Gerve, A. (Gesellschaft fuer Kernforschung, Karlsruhe, Ger.). Kerntechnik; 14: No. 5, 204-9 (May 1972). (In German and English).

Thin layer activation of machine parts, i.e., irradiation with charged particles, makes it possible to carry out wear measurements without any hazard even in ordinary industrial operations. The thin layer difference method of measuring wear is based on measuring the reduction of the activity of wear parts activated by the thin layer method. The achievable accuracy is better than 0.5 μm abrasion. The continuous flow method of measuring wear is based on measuring the total wear by measuring the time dependence of the variation in the activity concentration of abraded particles in the lubricating oil. The achievable accuracy is of the order of 10^{-6} g/h loss of material, even when several wear components are measured simultaneously. (auth)

45712 INVESTIGATION OF FREON FIRE-EXTINGUISHING SYSTEMS WITH A NUCLEONIC GAGE. Notea, A.; Segal, Y. (Technion-Israel Inst. of Tech., Haifa). Mater. Eval.; 30: No. 7, 153-6(Jul 1972).

The dynamic properties of the fire-extinguishing system in an aircraft were examined using a three-channel gamma attenuation gage connected to each outlet of the system. The extinguishing agent was Freon 13B-1 ($CBrF_3$), and the tube internal diameter was 0.774 cm. The gamma source, ^{241}Am, was selected by optimization of the standard deviation due to statistical counting fluctuations. The collimator arrangement allowed checking of 65% of the tube cross section. The results of mass changes with time during discharge of the system are shown. The changes of characteristic parameters—discharge time and full width half maximum time—are presented for different nozzle configurations. (auth)

45713 INVESTIGATION INTO THE APPLICATION OF POST-CUTTING CHIP ACTIVATION ANALYSIS TO THE STUDY OF TOOL WEAR. Prasad, Kadambi Narasimha. University Park, Pa.; Pennsylvania State Univ. (1971). 96p. University Microfilms Order No. 72-19,365.

Thesis.

Post-cutting chip activation analysis is a technique for measurement of tool wear rate that is analogous to the technique that employs radioactive tools. The essential difference between the two techniques is that in the former neutron activation is performed after the machining operation, using samples of chips, whereas in the latter the tool is activated before machining. The main advantage of the chip activation technique over activation of the tool is that the levels of radioactivity to be handled are lower by about a factor of 10^4. Gamma spectrometry is employed to identify and determine the tool material on the chips after activation. Two alternative approaches were examined in the application of this technique: one approach used the element tungsten as the neutron activable tracer, tungsten being an inherent constituent of the tools that were used; the second approach, examined for use where the first was not possible, employed a tracer inserted into the tool material specifically for the purpose of wear measurement. The tools used were made of the T-1 type of high speed steel for both approaches. Because of its favorable nuclear properties, europium was chosen as the neutron activatable tracer for the second approach. The titanium alloy Ti–6Al–4V was chosen as the work material for the investigation into the chip activation technique due to the relatively low level of trace tungsten concentration in the material. The precision of the activation analysis method to determine wear rates was found to be less than 3% at the 95% confidence level. The results of the tests showed that a correlation could be obtained between the break-in wear rate and tool life that could predict tool life to within the same margin of error that was obtained from the Taylor plot (cutting speed versus tool life) for the conditions used. (Diss. Abstr. Int., B)

Design and Fabrication

45714 (CONF-720902-2) FABRICATION OF ^{252}Cf NEUTRON SOURCES AT OAK RIDGE NATIONAL LABORATORY. Van Cleve, J. E. Jr.; Knauer, J. B.; Williams, L. C.; Bigelow, J. E. (Oak Ridge National Lab., Tenn.). [nd]. 5p. Dep. NTIS.

From National topical meeting on the applications of californium-252; Austin, TX, (11 Sep 1972).

The method of loading the californium in the aluminum liner and source encapsulation in the primary container are described. Identification numbers inscribed on the sources are prefixed with NSS or NSD to distinguish singly and doubly contained sources. The qualification of the source involves both a helium leak test and a x-radiograph. In helium leak testing, the leak rate of the source is compared with a standard leak. The ^{252}Cf content of each source is determined by measuring the fast neutrons emitted. This method is quick, accurate, and nondestructive. The counting rate is corrected for geometry, background, scattering due to miscellaneous objects, and scattering due to the source containers. The system has a reproducibility of $\pm 1\%$ in comparing sources with a standard source assayed during the same test period. The source is decontaminated in a water-shielded, portable decontamination facility. The clean source is shipped to the customer in a specifically designed 12-ton carrier. (auth)

45715 DETERMINATION OF ISODOSE CURVES OF SEALED γ-SOURCES BY CALCULATION AND FILM DOSIMETRY. Pavlicsek, I.; Csueroes, M.; Harsanyi, Gy (MTA Isotop Intezete, Budapest). Izotoptechnika; 15: No. 1, 25-36(Apr 1972). (In Hungarian).

The calculation of source distribution from dose rate distribution is discussed from the point of view of source construction. Isodose curves for gynecological sources in body-equivalent media are shown. (auth)

Industrial Uses

Refer also to abstracts: 45456 and 45457.

45716 (BFL-2/1972) INDUSTRIAL PROCESSING OF IRRADIATED POTATOES. Penner, H.; Gruenewald, Th.; Rumpf, G.; Gehse, M.; Wolf, W. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe (West Germany)). Mar 1972. 51p. (In German). Dep. NTIS (U. S. Sales Only).

In the framework of a joint experiment organized by the Bureau Eurisotop, Brussels, in several countries of the Common Market 10 tons of potatoes (varieties Bintje and Saturna) were treated with ionizing radiation in order to inhibit sprouting. The doses were 8.5 and 15 krads. After storage of 6 and 8 months (i.e., 7 and 9 months after harvest) these potatoes were processed into potato chips and dried potatoes. Seven tons of the same variety and origin were sprout inhibited by a mixture of Chlorpropham (CIPC) and Propham (IPC) or only IPC and stored and processed under the same conditions. Peelability showed no difference between irradiated and chemically-treated potatoes. Some of the radiation processed potatoes showed a grey discoloration. Due to a higher content of reducing sugars chips from irradiated potatoes were darker than controls of the same moisture content. After 6 months of storage the irradiated potatoes showed a higher amount of rot than the chemically-treated ones. (auth)

45717 RADIOISOTOPIC THICKNESS MEASUREMENTS IN THE MANUFACTURE OF WIRE. Plesch, Rolf (Siemens Aktiengesellschaft, Karlsruhe, Ger.). Siemens Rev.; 39: No. 5, 223-6(May 1972).

The use of radioactive isotopes enables wire thicknesses to be measured without physical contact during the production process and in this way the manufacturer is no longer forced to test random specimens of the end product. The method can be used to avoid the production flow and lowers rejection rate. A further advantage of this new method is a considerable saving on the materials sector, for the set point for the wire thickness can be brought nearer the minimum tolerance limit. (auth)

45718 RADIATION POLYMERIZATION OF IMPREGNATED POROUS MATERIAL. Hills, P. R.; McGahan, D. J. (Atomic Energy Research Establishment, Harwell, Eng.). Nucleus (Karachi) 8: No. 4, 33-42(1971).

The polymerization of impregnated porous material through the application of radiation is examined. (auth)

45719 FLUID IRRADIATING APPARATUS USING GAMMA RAYS AND HELICAL PASSAGEWAYS. Woodbridge, D. D.; Mann, L. A. (to Energy Systems, Inc.). Canadian Patent 897,930. 18 Apr 1972.

A gamma irradiator for the sterilization and treatment of liquids such as sewage and industrial wastes is described. The irradiator has a hollow center chamber and a spiralling input chamber. The liquid spirals around the center chamber and flows into it, passes through and into an elongated core member located in the center chamber, out a pipe which is helicially wrapped around the hollow member, and exits from the irradiator. Gamma radiation sources are located in the center chamber and around the elongated core member and may be placed in two parallel circles, one on each side of the helical exit pipe. Baffles may be located throughout the system to increase the turbulence, improving uniformity of radiation and preventing settling of solids. The irradiator is enclosed in shielding sides; inlets and outlets are curved or bent, and the cover for the shielding chamber is stepped in the usual manner. (Canada)

45720 INSTALLATION OF RADIOACTIVE SOURCES IN THE NO. 4 BLAST FURNACE AT CIA. FERRO BRASILEIRO FOR STUDYING LINING WEAR. Marri, Aluisio. Metalurgia (Sao Paulo); 27: No. 163, 443-7(Jun 1971). (In Portuguese).

Thirty ^{60}Co sources with individual activities ranging from 0.5 to 55.0 mCi and a total installed activity of 391.0 mCi were installed in the lining while the furnace was down for repairs. The sources were placed at depths of $\frac{1}{3}$, $\frac{1}{2}$, and $\frac{2}{3}$ the distance from the exposed inside surface of the lining on the assumption that $\frac{1}{3}$ of the thickness would be lost during the first 6 to 8 months of the new campaign, 50% by the end of $\sim 2\frac{1}{2}$ years and the remainder in ~6 years. Periodic measurement of the activity remaining at the various locations will determine whether these predictions are valid. Details are given concerning the locations of the sources in the lining, costs of installation and the program of measurement of radioactivity. Calculated figures are presented on the possible activity in a piece of steel pipe made from a heat in which one of the most active sources (55.0 mCi) may have been entrained and the absence of a safety problem attributable to the use of such a pipe in a main supplying water for human consumption. (Metals Abstr.)

45721 RADIOISOTOPES AND TURBINE FLOW MEASUREMENTS. Schuster, Jack S.; Hansen, Robert L. (Bureau of Reclamation, Denver). J. Power Div., Amer. Soc. Civil Eng.; 98: PO-1, 1-9(Jun 1972).

Results are reported on research directed to measuring discharge through high-head turbines and pumps using radioisotope tracers. A series of measurements was made to compare the relative accuracy of methods involving radioisotope—velocity measurements, integrated sample measurements, dilution measurements, and total-count measurements. Results of these investigations did not show a major advantage to one particular method. Each method has its advantages and disadvantages and can be considered for a particular situation. (J.R.D.)

LIFE SCIENCES

Radiation Effects on Biochemicals (External Source)

Refer also to abstract: 45349.

45722 (COO-3232-1) MOLECULAR BASIS FOR THE MUTAGENIC AND LETHAL EFFECTS OF ULTRAVIOLET IRRADIATION. Progress Report, June 16, 1971-May 31, 1972. Grossman, Lawrence (Brandeis Univ., Waltham, Mass.). Contract AT(11-1)-3232. 6p. Dep. NTIS.

Research was conducted on elucidation of the enzyme mechanism by which uv-damaged DNA is repaired. The following steps in the excision repair cycle are discussed: incision, catalyzed by an endonuclease from Micrococcus luteus; reaction with formaldehyde; excision, catalyzed by an exonuclease; and reinsertion mechanisms involving DNA polymerase. (H.L.W.)

45723 RADIATION EFFECTS ON PLASMA ELECTRON-SPIN-RESONANCE (ESR) SPECTRA OF CANCER PATIENTS. Swartz, Harold M.; Wiesner, James (Medical Coll. of Wisconsin, Milwaukee). Radiology; 104: No. 1, 209-10(Jul 1972).

In studies of blood plasma of cancer patients, the average magnitudes of several electron-spin-resonance peaks were seen to be significantly increased, apparently as the result of increased amounts of paramagnetic trace elements. Thirty patients studied during radiation therapy showed a trend back toward control levels, with the greatest response found in patients with squamous-cell carcinoma. (auth)

45724 EFFECT OF GAMMA IRRADIATION ON FUERTE AVOCADO FRUITS. Kamali, A. R.; Maxie, E. C.; Rae, H. L. (Univ. of California, Davis). HortScience; 7: No. 2, 125-6 (Apr 1972).

Gamma irradiation up to 100 Krad caused no immediate visual damage to fruits of avocado (Persea americana Mill.). Twenty Krad or more stimulated a climacteric-like rise in respiratory rate. Rates of ethylene (C_2H_4) production were related directly to dose up to 40 Krad. Ten and 40 Krad delayed the climacteric peak for 3 days. Softening was delayed by 10 Krad and hastened by 40 and 100 Krad. At 100 Krad, ripening was lacking and the fruit severely injured. No benefit remained from any dose after 3 weeks of storage. Storage reduced the time required for ripening by 2 days, and enhanced the development of injury symptoms and pigment degradation. (auth)

45725 EFFECT OF WATER ON THE RADIOSENSITIVITY OF PLASMATIC FATTY ACIDS. Dousset, N.; Douste-Blazy, L. (Univ., Toulouse). Compt. Rend. Soc. Biol.; 165: No. 6, 1462-5(1971). (In French).

Water prevents the appearance of liquid peroxides in plasma subjected to x radiation (20,000 roentgens). Lyophilized plasma is more radiosensitive than liquid plasma; the irradiation induces the formation of lipidic peroxides, principally at the expense of the linoleic and oleic acids without modifying the free fatty acids. (France)

45726 POSSIBILITIES IN STUDYING THE MECHANISM OF RADIOSENSITIVITY OF AND RADIATION DAMAGE TO ALBUMINES AND NUCLEIC ACIDS. Damjanovich, S. (Debreceni Orvostudomanyi Egyetem Biofizikai Intezete, Hungary). Izotoptechnika; 15: No. 3-4, 143-53(1972). (In Hungarian).

A survey of literature and results of experiments prove that a single irradiation does not alter considerably the conformation of enzyme, or lower tolerance to heat. The effect can be observed in the regulation and, to a smaller extent, in the activity of the enzyme. (auth)

45727 IN VITRO REPAIR OF UV-INACTIVATED TRANSFORMING DNA FROM BACILLUS SUBTILIS. Heijneker, H. L.; Pannekoek, H.; Oosterbaan, R. A.; (and others) (Medical Biological Lab., TNO, Rijswijk, Netherlands. Univ., Groningen, Netherlands). Genen Phaenen; 15: No. 1, 31-2(Jun 1972). (In Dutch).

Three specific enzymes, uv-specific endonuclease, DNA polymerase, and DNA ligase, were found to be involved in the in vitro repair of uv-induced damage in DNA. (auth)

45728 ULTRAVIOLET INACTIVATION AND MISCODING OF IRRADIATED R17-RNA IN VITRO. Remsen, Joyce F.; Cerutti, Peter A. (Univ. of Florida, Gainesville). Biochem. Biophys. Res. Commun.; 48: No. 2, 430-6(25 Jul 1972).

Ultraviolet irradiation of the single-stranded Coliphage R17 leads to inactivation of the in vitro messenger activity of its RNA. Uridine-photohydration is the major reaction occurring in the RNA under these conditions. At a residual activity of the synthetase gene of 37%, there are 11.2 uridine-photohydrates present in the total R17 genome, while only 5.3 photohydrates are necessary to decrease the translation of the coat gene to the same value. De novo incorporation of histidine into the coat protein is observed with R17-RNA from uv-irradiated phage, indicating that uridine-photohydrates can miscode as cytidine in an in vitro translation system. (auth)

45729 RESPIRATORY QUOTIENTS OF IRRADIATED FRUITS. Ahmed, E. M.; Dennison, R. A.; Green, G. F. (Univ. of Florida, Gainesville). J. Amer. Soc. Hort. Sci.; 97: No. 3, 373-6(1972).

An automatic sampling system for monitoring CO_2 evolution and O_2 uptake of irradiated fruits under a continuous air flow was used. All fruits showed increased respiratory activities immediately following irradiation. The respiratory activities of irradiated tomatoes and strawberries decreased within 24 hr following irradiation, while those of oranges and grapefruit remained at elevated levels. The respiratory quotients (RQ) of irradiated citrus fruits were higher than those for control fruits, while those of tomatoes and strawberries were not. All RQ values were less than unity. (E.R.B.)

45730 CHEMICAL AND PHYSICAL CHANGES OF DEXTRAN 4000 IRRADIATED WITH VARIOUS DOSES OF γ-RADIATION. Derlikowski, J.; Szyszko, E.; Zagorski, Z. P. (Inst. for Drug Research and Control, Warsaw. Inst. of Nuclear Research, Warsaw). Diss. Phar. Pharmacol.; 23: 253-7(1971).

Preparation "Dextran" of mean molecular weight 40000 (dry powder) decomposes under the influence of γ rays. The preparation cannot be sterilized by γ irradiation. (NSA of Poland)

45731 SEMI-IN VITRO REPAIR OF RADIATION-INDUCED DAMAGE IN TRANSFORMING DNA OF BACILLUS SUBTILIS. Noguti, T.; Kada, T. (National Inst. of Genetics, Shizuoka, Japan). J. Mol. Biol.; 67: No. 3, 507-12(28 Jun 1972).

Toluene-treatment at 0°C was effective in making Bacillus subtilis cells accessible to substrates and co-factors of enzymes involved in the repair of damage induced by ionizing radiation. Transforming activity in the lysate of γ-irradiated (30 Krads) and toluene-treated bacteria increased remarkably in the presence of four deoxynucleoside triphosphates, nicotinamide adenine dinucleotide, and Mg^{2+} at 37°C. Under similar conditions, γ-ray induced DNA single-strand breaks were rejoined to a significant extent. Involvement of DNA-polymerase and DNA-ligase functions was strongly suggested in the repair of DNA damage induced by ionizing radiation. (auth)

45732 BIOCHEMICAL MECHANISMS IMPLIED IN THE SENSITIZATION OF LIVING ORGANISMS BY CHEMICALS UNDER THE EFFECT OF RADIATIONS AND CYTOSTATICS. III. THE EFFECT OF HMB, IAA, AND CAFFEINE UPON THE DNAase ACTIVITY IN THE LIVER OF NORMAL OR IRRADIATED RATS. Furnica, M.; Ganea, A. Rev. Roum. Biochim.; 8: No. 3, 211-18(1971). (In French).

p-Hydroxymercurybenzoic (HMB) acid in 15 mg/kg body weight and iodoacetamide (IAA) in 15 mg/kg body weight were given to normal or 800 R irradiated rats and the activity of liver DNA-ase was followed. Three days after the treatment, DNA-ase inhibition in normal animals and its relative activation (compared to the irradiated controls) in the irradiated animals were reported. DNA-ase activation in the irradiated animals and radiosensitivity could be involved in the inhibition and irradiation damaged DNA restoration. Caffeine in doses to 100 mg/kg body weight did not alter liver DNA-ase activity. (Rom. Sci. Abstr.)

45733 EFFECT OF X-RAY IRRADIATION ON GLUTATHIONE PEROXIDASE. Olinescu, R. Rev. Roum. Biochim.; 8: No. 3, 231-8(1971).

X-ray effect upon glutathione peroxidase extracted from swine blood and 2500 times purified was investigated. Irradiation was conducted in atmospheric air at 0°C with a 2 KR/min dose. Hydroperoxidase used as substrate protected the regulating and catalytic functions of glutation peroxidase. The regulating function of GSH peroxidase is more radiosensitive than its catalytic one. The regulating function is affected at different places. It being however, in the neighborhood of the catalytic one. The stimulation of peroxidase activity governed by NADPH is counteracted upon irradiation contamination. GSH peroxidase in the swine liver, even less purified, is not as radiosensitive as the blood enzyme, where either the catalytic or allosteric functions are concerned. (Rom. Sci. Abstr.)

Radiation Effects on Cells (External Source)

Refer also to abstracts: 45611 and 45612.

45734 EFFECT OF TAURINE AS A PROTECTOR OF HUMAN MARROW CELLS AGAINST RADIATION. Marchionni, R.; Bersi, M. (Verbania Hospital, Italy). Arch. Sci. Med.; 126: No. 1, 20-2(1969). (In Italian).

Chromosome fragmentation counts on irradiated human marrow cells were used to determine the radioprotective effect of taurine. The results were unfavorable in the sense that the number of fragmentations observed in cultures to which taurine had been added was only slightly less than that in the control cultures. (auth)

45735 QUANTITATIVE AND QUALITATIVE ASPECTS OF RADIOBIOLOGY AND THEIR SIGNIFICANCE IN RADIATION THERAPY. Wideroee, R. (Brown, Boveri and Co. Ltd., Baden, Switzerland). Acta Radiol., Ther., Phys., Biol.; 10: No. 6, 605-24(Dec 1971).

The survival of mammalian cells in proliferating cell cultures exposed to various types of radiation is described and analyzed mathematically. Such investigations neglect the influence of milieu and different qualitative cell reactions. The results should therefore not be transferred indiscriminately to clinical treatment. However, general directions for treatment schemes using various types of radiation can be determined and cell parameters chosen that correspond well to present clinical experience. (auth) (Sweden)

45736 USE OF A MODEL OF TWO CLASSES OF TRYPTOPHAN RESIDUES FOR INTERPRETING THE RESULTS OF ULTRAVIOLET FLUORESCENCE OF CELLS EXPOSED TO X-RAYS. Ostashevskii, I. Ya.; Yagunov, A. S. (Central Scientific-Research Roentgeno-Radiological Inst., Leningrad). Biophysics (USSR) (Engl. Transl.); 16: No. 5, 834-40(1971).

Translated from Biofizika; 16: No. 5, 802-7(1971).

The ultraviolet fluorescence spectra of x-irradiated (500 rads) and unirradiated Ehrlich ascites carcinoma cells were studied. An increase in the intensity (I_{max}), and a longwave shift was demonstrated in the fluorescence spectrum in irradiated cells. Analysis of this experimental fact and the reciprocal relation between the slope of the dose relation and the value of the initial intensity within the framework of the model of two classes of tryptophan gave preference to a mechanism whereby there is increase in the quantum yield of the red tryptophans with no change in the fractions of the residues of each. (auth)

45737 INDUCTION OF UNSCHEDULED DNA SYNTHESIS BY HALF-NUCLEUS IRRADIATION OF HeLa CELLS WITH AN UV-MICROBEAM IN COMBINATION WITH HYDROXYUREA TREATMENT. Yatani, Ryuichi (Mie Prefectural Univ., Tsu, Japan). Mie Med. J.; 20: No. 2, 93-104(Sep 1970).

Radiobiological properties of half-nucleus irradiation in HeLa cells treated with hydroxyurea were observed. The rates of unscheduled DNA synthesis during different phases of the cell cycle of HeLa cells were calculated from autoradiographic results obtained by technique of half-nucleus irradiation with an uv-microbeam in combination with hydroxyurea treatment. It was suggested that the S-phase was more sensitive to uv-irradiation and subsequently to the induction of unscheduled DNA synthesis than the other phases. (Japan)

45738 EFFECT OF X-IRRADIATION ON MACROPHAGES AND TUMOR CELLS Co-CULTIVATED IN VITRO. Vorbrodt, A.; Grabska, A.; Steplewski, Z. (Inst. of Oncology, Gliwice, Poland). Folia Histochem. Cytochem. (Krakow); 9: 153-8 (1971).

The effect of x-ray (1300 R) on the phagocytic activity of macrophages co-cultivated with tumor cells (ELD and C3HM) was studied. It was found that after irradiation phagocytic activity of macrophages was stimulated, as evidenced by their enlargement, increased number and size of lysosomes, engulfing, and phagocytosis of x-irradiated tumor cells. The significance of these observations is discussed in relation to the mechanisms involved in the phagocytosis of irradiated tumor cells. (NSA of Poland)

45739 FACTORS AFFECTING RADIATION SENSITIVITY. Quintiliani, Marcello. Ann. Ist. Super. Sanita; 7: 647-60 (1971).

An attempt is made to organize the available data on the lethal effects of radiation on single cells into a coherent pattern. A large body of experimental evidence demonstrates that radiosensitivity depends on a variety of factors, ranging from the stage in the cell cycle to the oxygen pressure and from the degree of hydration to the presence of a variety of added substances. Some of these intrinsic and environmental modifications are discussed. (E.R.B.)

45740 SPONTANEOUS AND X-RAY INDUCED MUTATION IN CULTURED, DIPLOID HUMAN CELLS. Albertini, Richard Joseph. Madison, Wis.; Univ. of Wisconsin (1972). 248p. University Microfilms Order No. 72-15,335.

Thesis.

A system was developed to detect somatic cell mutation to 8 azaguanine resistance in normal, cultured, diploid human fibroblasts. Hypoxanthine-guanine phosphoribosyltransferase (HG-PRT) deficient, 8 azaguanine (8AG) resistant fibroblasts from boys with the Lesch-Nyhan Syndrome served as prototype mutant cells. Such cells are known to be mutant at an X-linked genetic locus—the hpt locus. Both spontaneous and x-ray induced mutation were studied. Preliminary x-ray studies are described that determined clonal survival of cultured human fibroblasts as a function of x-ray dose. 250 R allowed 20% survival. Numerous reconstruction experiments assessed efficiency of recovery of prototype mutant cells from majority populations of normal cells. Recovery was a function of both cell density and 8AG concentration, with optimum recovery achieved at an initial inoculum of 2×10^4 cells per 60 mm plastic dish selected at a concentration of 8×10^{-6} M 8AG. Efficiency of recovery was between 60 and 90%. Internal reconstructions were included in all subsequent mutagenesis experiments. Attempts to purify normal cell populations of pre-existing 8AG resistant mutant cells by HAT (hypoxanthine, aminopterin, thymidine) reverse selection against the mutants failed. Such pre-existing mutants were therefore carried into mutagenesis experiments where they biased estimations of spontaneous mutant clone frequencies. Five mutagenesis experiments are reported. Irradiated and unirradiated cell populations were studied. In two experiments, one dose of x rays was administered (250 R) while in the remainder two or three doses were given. Spontaneous mutation rate was estimated to be 4.5×10^{-6} per cell generation which was an overestimation because of pre-existing mutants. Spontaneous mutant clone frequency was subtracted in irradiated populations to determine induced mutant clone frequency. Induction of mutation by x rays was shown to be dose-dependent with increases occurring in a non-linear cumulative fashion. Induced mutation rates were estimated at 1.13×10^{-9} per R per locus for 75 R, 8.5×10^{-8} per R per locus for 125 R, 6.87×10^{-8} per R per locus for 150 R, and 2.6×10^{-7} per R per locus for 250 R. Study of derived mutant substrains showed these to be no more x-ray resistant than parental strains. HG-PRT activity was determined to be deficient in over 80% of them, although not as deficient as in L-N prototype mutant cells. All derived substrains studied could grow in both 8AG and in HAT medium. The triad of HG-PRT deficiency, 8AG resistance, and HAT growability described a class of mutant human fibroblasts heretofore unrecognized. Studies are also described that attempt to detect 8AG-resistant lymphocytes in human blood samples. Detection can be made with a sensitivity approaching 1%. A minority population of 8AG resistant cells comprising 5 to 10% of the total was found in young females heterozygous for the Lesch-Nyhan mutation. Since such cells are not detected in populations of lymphocytes from normals, the system may have use as an adjunctive heterozygous detection test. Other applications are discussed. (Diss. Abstr. Int., B)

45741 REGULATION OF GRANULOCYTE AND MACROPHAGE FORMATION IN DIFFUSION CHAMBER CULTURES OF MOUSE HAEMATOPOIETIC CELLS. Breivik, H. (Norwegian Defence Research Establishment, Kjeller); Benestad, H. Breien. Exp. Cell Res.; 70: 340-8(Feb 1972).

Bone marrow and blood cells from mice were cultured in peritoneal diffusion chambers in homologous recipients. Granulocytes and macrophages were formed in the chambers. About a quarter of the blood lymphocytes were recovered after the culture period, whilst bone marrow lymphocytes almost disappeared. The number of granulocytes harvested was linearly related to the number of cells implanted, indicating that growth regulatory cell interactions did not take place in the chambers. Regenerating bone marrow produced twice as many granulocytes per progenitor cell as did normal marrow. The cell yield was also increased when irradiated or cyclophosphamide pretreated chamber hosts were employed. Thus properties of the progenitor cells as well as humoral factors from the hosts did influence chamber granulopoiesis. In contrast to the growth results for granulocytes, the formation of macrophages showed a relative decrease when the cell inocula were increased. Pretreatment of the host mice with irradiation or with cyclophosphamide resulted in increased macrophagopoiesis in bone marrow cultures. (auth)

45742 VARIOUS LEVELS OF DNA REPAIR SYNTHESIS IN XERODERMA PIGMENTOSUM CELLS EXPOSED TO THE CARCINOGENS N-HYDROXY AND N-ACETOXY-2-ACETYLAMINOFLUORENE. Stich, H. F.; San, R. H. C.; Miller, J. A.; Miller, E. C. (British Columbia Univ., Vancouver). Nature (London) New Biol.; 238: No. 79, 9-10(5 Jul 1972).

A study was made, by ^{3}HTdR incorporation methods, of the levels of DNA repair synthesis in Xeroderma pigmentosum (XP) cells of 5 patients exposed to the carcinogenic and mutagenic compounds N-acetoxy- or N-hydroxy-2-acetyl-aminofluorene, which are ultimate and proximate carcinogenic forms of 2-acetylaminofluorene (AAF). Experiments with normal human fibroblasts showed that at equimolarity, N-acetoxy-AAF was more active than N-hydroxy-AAF in producing DNA lesions resulting in repair synthesis. AAF alone showed a very weak capacity for eliciting DNA repair synthesis. Reduced repair capacities were observed in all cultured XP cells exposed to N-hydroxy-AAF or N-acetoxy-AAF. The levels of impairment between unrelated patients differed significantly, but the results between brother and sister were comparable. A comparison was made of the degree of DNA repair synthesis in XP cell cultures exposed to uv irradiation (1,000 ergs/mm^2), 4-nitroquinoline-1-oxide (4 NQO) and N-methyl-N-nitroso-N-nitroguanidine (MNNG). The level of DNA repair synthesis was specific for each XP cell culture and barely affected by the type of initiating agent used. (UK)

45743 CONFIRMATION OF LESIONS HAVING THE POTENTIAL FOR FORMING CHROMOSOMAL ABERRATIONS. Dewey, W. C. (Colorado State Univ., Ft. Collins). Int. J. Radiat. Biol.; 22: No. 1, 95-7(Jul 1972).

Late S phase synchronized Chinese hamster ovary cells were x-irradiated with doses of 600 rads of 49 keV energy, and subsequently examined for chromosomal aberrations under different temperature conditions. Chromosomal damage was the same when the cells were irradiated at either 20° or 37°C, if the cells were placed at 37°C immediately after irradiation. When the temperature was lowered to 20°C after irradiation, the amount of chromosomal damage was reduced as the repair of potential damage was reduced, with a half-time of about 15 min. When the cells were placed at 20°C for 2 hr after a 2 min period at 37°C, confirmation of potential damage appeared to have been completed. (UK)

45744 EFFECTS OF X-IRRADIATION IN VITRO ON THE TRANSPORT OF POTASSIUM IONS IN THYMOCYTES. Chapman, I. V.; Sturrock, M. G. (Dundee Univ., Scotland). Int. J. Radiat. Biol.; 22: No. 1, 1-9(Jul 1972).

Rat thymocytes were exposed to x radiation in the dose-range 0.2 to 20 Krads in vitro. The decrease in intracellular potassium levels produced is attributed to two separate mechanisms: inhibition of active transport and increased membrane permeability. Evidence for both mechanisms is sought by ^{42}K tracer studies and flame photometry. The influence of ouabain, incubation at 6° to 10°C, and choline chloride media is studied, both in relation to total potassium changes and in the inhibition of influx rates of potassium ions. (auth)

45745 REPAIR OF A DNA COMPLEX FROM X-IRRADIATED CHINESE HAMSTER CELLS. Elkind, M. M.; Chang-Liu, C.-M. (Hammersmith Hospital, London). Int. J. Radiat. Biol.; 22: No. 1, 75-90(Jul 1972).

Using velocity sedimentation in alkaline gradients of the DNA from Chinese-hamster cells, damage and repair processes were studied as a function of x-ray dose. DNA-containing material released by alkaline lysis is initially contained in a complex-containing lipid, the sedimentation of which was anomalous relative to denatured DNA from unirradiated cells. Doses of x rays small enough to be in the range that permits high survival (i.e., 100 to 800 rads) accelerated the resolution of single-stranded DNA from this DNA complex, giving rise to a species having a number average molecular weight of 2×10^8 dalton. Large doses, greater than 1000 to 2000 rads, resulted in degradation of these DNA strands. Incubation for 20 min at 37°C or 25°C after irradiation resulted in the rapid repair of both forms of damage, although the rate of repair of damage to the complex decreased with increasing dose. Repair of radiation damage to the complex resulted in a reassociation of lipid and DNA. The evidence supported the possibility that a large DNA-membrane structure was the principal target of radiation. (auth)

Radiation Effects on Microorganisms (External Source)

Refer also to abstracts: 45728, 45731, 45859, and 45899.

45746 LETHAL AND MUTAGENIC EFFECT OF IONIZING RADIATIONS WITH DIFFERENT LET ON EXTRACELLULAR BACTERIOPHAGES. Shelegedin, V. N.; Bresler, S. E.; Kriviskii, A. S.; Rybchin, V. N.; Serdyuk, L. G. (Polytechnic Inst., Leningrad. Inst. of Genetics of Micro-organisms, Moscow). Stud. Biophys.; 28: No. 3, 213-21(1971). (In Russian).

The inactivating and mutagenic effects of high energy radiations were studied using the extracellular phages C_d and λ_{11} as objects. The experimental data show that both phages in the state of dry films are inactivated exponentially and almost equally by γ rays and high energy protons and with increased D_{37} by the accelerated heavy ions ^{12}C and ^{20}Ne. The inactivation rates are roughly proportional to the molecular weight of the phage DNA. In broth, the equality of both γ radiation and protons inactivating effects is also found, but the figures for inactivation rates are increased more than four times in comparison with the dry samples. Probably it is due to the effect of reaction cage well known in radiation chemistry. This was confirmed by the measurement of inactivation rate in frozen broth at the temperature of liquid nitrogen. The inactivation rate by heavy ions (^{12}C and ^{20}Ne) is 4 to 5 times lower than by γ quanta or protons. This is probably due to inhomogeneity of ionization. But the yield of mutants is the same for all three radiations if plotted against inactivation rate. This shows that the mechanism of damage is substantially identical. (auth)

45747 EFFECT OF COMBINED METHODS ON CLOSTRIDIUM SPOROGENES INOCULATED IN SAUSAGE. Incze, K. (Orszagos Husipari Kutatointezet, Budapest); Farkas, J. Izotoptechnika; 15: No. 3-4, 172-8(1972). (In Hungarian).

Combination of mild heat treatment and irradiation leads to a two to threefold lengthening of storage time of tinned sausage. Nitric brine improves storability. (auth)

45748 DETERMINATION OF MICROBIAL CONTAMINATION OF DISPOSABLE MEDICAL DEVICES AND THE ESTIMATION OF RADIOSENSITIVITY OF ISOLATED MICROFLORA. Gazso, L.; Igali, S.; Varteresz, V. (Frederic Joliot-Curie Sugarbiologiai es Sugaregeszsegugyi Kutato Intezet, Budapest). Izotoptechnika; 15: No. 3-4, 187-91(1972). (In Hungarian).

Needles, connected to radiosterilized syringes, are washed with 10 ml 0, 1% peptonic solution; the needle is shaken for 30 min in the wash; which, after filtration through 0, 45 μ membrane filter, is incubated on agar plate with trypton-glucose-yeast concentrate at 32°C for 3 days. The number of colony-producing units is determined for 3 days. (auth)

45749 INVESTIGATIONS ON THE RADIOSENSITIVITY OF YEASTS. Kiss, I. (Kozponti Elelmiszeripari Kutato Intezet, Budapest). Izotoptechnika; 15: No. 3-4, 167-71(1972). (In Hungarian).

The D_{10} value of yeasts can reach those of bacterial spores. The lethal radiation dose can be determined with the help of survival curves and the factors modifying them. (auth)

45750 MICROBE-GENETICAL PROBLEMS OF RADIOSTERILIZATION. Igali, S. (Frederic Joliot-Curie Sugarbiologiai es Sugaregeszsegugyi Kutato Intezet, Budapest). Izotoptechnika; 15: No. 3-4, 160-6(1972). (In Hungarian).

In case of avoiding mass resterilization and mass reproduction of microorganisms in the sterilized product the probability of appearance of radioresistant spore populations is very low. (auth)

45751 BIOCHEMICAL FOUNDATIONS OF SPORE RESISTANCE. Csuzi, S. (Orvosi Vegytani Intezete, Budapest). Izotoptechnika; 15: No. 3-4, 154-9(1972). (In Hungarian).

According to literature data on the radioresistance of spores, a significant role is played by the lowered water content, the enrichment of spore mantle in disulfides, and the non-existence of DNA synthesis. (auth)

45752 IMMUNOGENICITY OF PURIFIED VENEZUELAN EQUINE ENCEPHALITIS VIRUS INACTIVATED BY IONIZING RADIATION. Gruber, Jack (Medical Sciences Lab., Frederick, Md.). Infec. Immunity; 3: No. 4, 574-9(Apr 1971).

Purified and concentrated Venezuelan equine encephalitis (VEE) virus derived from tissue cultures, rendered noninfectious by ionizing radiation with retention of in vitro serological activity, also retained a high level of immunogenicity. In mice, fluid vaccines afforded excellent protection against lethal-challenge with homologous Trinidad strain VEE virus. A direct relationship was observed between concentration of vaccine or number of injections and survival. One intraperitoneal inoculation of undiluted vaccine protected essentially all mice challenged 21 days later with 100,000 mouse intraperitoneal LD_{50} of virus. Similarly, mice receiving three injections of vaccines diluted 1:100 were completely protected. Noninfectious VEE virus preparations combined with adjuvant 65, a nontoxic metabolizable vehicle, were likewise very effective in protecting mice immunized intraperitoneally or subcutaneously against lethal challenge. Guinea pigs immunized subcutaneously with adjuvant-combined vaccine survived lethal challenge of 1,000,000 guinea pig intraperitoneal LD_{50}. (auth)

45753 DNA SYNTHESIS IN GAMMA-IRRADIATED RECOMBINATION DEFICIENT STRAINS OF ESCHERICHIA COLI.

Gray, W. J. H.; Green, M. H. L.; Bridges, B. A. (Sussex Univ., Brighton, Eng.). J. Gen. Microbiol.; 71: No. 2, 359-66(Jul 1972).

DNA synthesis in recA and recA exrA strains of Escherichia coli was strongly inhibited without delay by low doses of gamma-radiation (0 to 10 Krads). The synthesis that did occur in these strains appeared to take place mainly on chromosomes that had not received a lethal hit. Low doses produced much less inhibition of DNA synthesis in exrA, recB, recA recB, and wild-type strains. It was concluded that the $recA^+$ gene product acted immediately, certainly before DNA replication, in the repair of lesions produced by gamma irradiation. In recB bacteria, the $recA^+$ gene product was not required for continued DNA synthesis, although the synthesis that occurred in recA recB strains may have been abnormal since it was not reflected in increased survival. The $exrA^+$ gene product was not necessary for continued DNA replication, suggesting that its time of action in repair may be at a later stage. (UK)

45754 CHANGES IN SENSITIVITY OF CELLS DURING EXPOSURE TO RADIATION AT LOW DOSE RATE. Bryant, P. E. (Hammersmith Hospital, London). Int. J. Radiat. Biol.; 22: No. 1, 67-73(Jul 1972).

A large sparing effect was observed for Chlamydomonas reinhardii when dose-rate was reduced. Cells given radiation (5 MeV electrons) at low dose-rate (20 Krads/min) were subsequently given series of graded doses at a high dose-rate (200 Krads/min). Values of D_0 were larger, and extrapolation numbers lower for survival curves at high dose-rate, following low dose-rate pre-treatment, than if no pre-treatment had been given. The processes that led to a change in sensitivity of cells, and lower extrapolation numbers for survival curves at high dose-rate following low dose-rate pre-treatment, may have contributed to the overall sparing effect of a reduction in dose-rate. Because the shape of the split-dose survival curve at high dose-rate was different from that of the single-dose survival curve, current models, that relate changes in shapes of survival curves as dose-rate is reduced to recovery of cells from sublethal damage, could not be applied. (auth)

Radiation Effects on Plants (External Source)

45755 (TID-25954) RADIOECOLOGY AND ECOPHYSIOLOGY OF DESERT PLANTS AT THE NEVADA TEST SITE. Wallace, A.; Romney, E. M. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology. California Univ., Riverside). 1972. Contract AT-04-1-GEN-12. 446p. Dep. NTIS.

Separate abstracts were prepared on 18 papers. Additional papers discuss the characteristics, ecology, and mineral cycling in plants indigenous to the Nevada Test Site. (C.H.)

For abstracts of individual papers see: 45192, 45193, 45756–45769, 45914, and 45923.

45756 (TID-25954, pp 5-11) EFFECTS OF A CHRONIC LEVEL OF GAMMA RADIATION FOR 5 YEARS ON SHRUBS IN THE NORTHERN MOJAVE DESERT. 1972.

In Radioecology and ecophysiology of desert plants at the Nevada Test Site.

A 33,600 curie ^{137}Cs γ source which was differentially shielded to increase the uniformity of the distribution of radiation was mounted on a 15-m tower in the center of a 9-hectare plot in January 1964 in the Rock Valley area of the northern Mojave Desert. In the spring of 1969 the large majority of approximately 5000 Ephedra nevadensis within the plot failed to produce flowers and very little vegetative growth occurred in contrast to a control plot and to other nonirradiated areas. The cumulative radiation exposure throughout the plot ranged from 3 to 29 kR. Radiation effects on Lycium andersonii were uncertain and effects were doubtful on other species. E. nevadensis and L. andersonii have higher nuclear volume than do the other shrub species. Considerable resistance to γ radiation was experienced for several of the other species given acute exposure under laboratory conditions. (auth)

45757 (TID-25954, pp 12-48) AN ASSESSMENT OF THE SEASONAL GROWTH ON SOME DESERT SHRUBS SUBJECTED TO CHRONIC LOW INTENSITY GAMMA RADIATION. 1972.

In Radioecology and ecophysiology of desert plants at the Nevada Test Site.

A study to assess the effects of low intensity chronic γ irradiation on desert shrubs was conducted adjacent to the Nevada Test Site. From February 1964 to September 1967 a careful record was kept concerning the qualitative and quantitative responses of six dominant species (Ephedra nevadensis; Franseria dumosa; Grayia spinosa; Larrea divaricata; Lycium andersonii; and Lycium pallidum) in an irradiated and a control plot. The data reported represent over one-half million observations of tagged terminal shoots on these shrubs. Although definite radiation effects on these species were inconclusive at the time when the study was concluded, valuable information relative to seasonal dynamics in these plants is presented. Specific data are presented relative to desert community composition and the climatic and edaphic profiles which characterize the area. (auth)

45758 (TID-25954, pp 49-53) EFFECTS OF GAMMA RADIATION ON SEED GERMINATION AND SEEDLING SURVIVAL. 1972.

In Radioecology and ecophysiology of desert plants at the Nevada Test Site.

Seeds of several species of desert plants were irradiated with a ^{60}Co γ source at various exposures and characteristics of germination and seedling survival were recorded. In general the radiation had a greater effect on seedling survival than on germination. The sensitivity of the species to the radiation was greatly related to nuclear volume. Few Artemisia tridentata seedlings survived for radiation levels above 15 kR and for Yucca schidigera, above 20 kR. Larrea divaricata was little affected by levels up to 40 kR while Atriplex canescens, Franseria dumosa, Yucca brevifolia, and Salsola pestifera were much more resistant to the radiation. (auth)

45759 (TID-25954, pp 54-7) RADIATION DAMAGE ON NATURAL VEGETATION IN CLOSE-IN FALLOUT AREAS. 1972.

In Radioecology and ecophysiology of desert plants at the Nevada Test Site.

Both β and γ radiation contributed to the damage of vegetation in close-in fallout areas at the Nevada Test Site inasmuch as their effects were additive. However, because of its inherent nature, beta radiation contributed the most damage when fallout debris was deposited upon and retained by plant foilage. Where fallout radiation levels were sufficiently high, complete defoliation and kill of natural vegetation occurred, and, in areas of fallout patterns peripheral to where all or most plants were killed, the radiation damage to shrubs was often manifested in a particular fashion which depended upon the manner in which fallout debris was deposited. (C.H.)

45760 (TID-25954, pp 65-8) SENSITIVITY OF DESERT PLANTS TO ACUTE GAMMA RADIATION. 1972.

In Radioecology and ecophysiology of desert plants at the Nevada Test Site.

The radiation sensitivity of some 30 different species of desert plants was compared in the laboratory using a 10,000 curie ^{60}Co γ source. Some deciduous plant species were difficult to score because of their inherent tendency to become dormant under environmental stress. Dormant plants survived much higher levels of radiation than actively growing plants. The findings reported here are for plants irradiated in a succulent, vegetative state. Based upon a limited amount of data, the order of decreasing sensitivity to acute gamma radiation generally was the same as the order of decreasing nuclear volume or ICV of the species. (auth)

45761 (TID-25954, pp 73-4) EFFECT OF ^{60}Co RADIATION ON EMERGENCE AND SEEDLING GROWTH OF LYCIUM PALLIDUM AT TWO LEVELS OF HYDRATION. 1972.

In Radioecology and ecophysiology of desert plants at the Nevada Test Site.

Dry and moist seeds of Lycium pallidum were exposed to doses of 0, 5 kR, 10 kR, and 20 kR of ^{60}Co γ radiation. Control seeds were oven dried at 105°C for 24 hours to establish the moisture content of the seed. Immediately after radiation treatment the seeds were sown in fine vermiculite in clay pots and placed in a glasshouse (temperature range 15 to 25°C) to observe emergence of seedlings. Indications of this study are that dry seed of L. pallidum will tolerate 10 kR of radiation and that moist seed will tolerate 5 kR, without significantly diminishing the emergence of seedlings or their early survival. At radiation levels much in excess of these, however, the rate of emergence declined sharply and the emerged seedlings had a low survival rate. (C.H.)

45762 (TID-25954, pp 75-86) REVEGETATION IN AREAS DAMAGED BY CLOSE-IN FALLOUT FROM NUCLEAR DETONATIONS. 1972.

In Radioecology and ecophysiology of desert plants at the Nevada Test Site.

Revegetation changes were followed in the close-in fallout area of a plowshare nuclear test at Nevada Test Site which killed most of the native vegetation in one area and severely damaged it in others. The Artemisia species dominate the vegetation of this area at Pahute Mesa. In the partially damaged area, Artemisia seedlings are reestablishing themselves but the area has become a grassland and few Salsola are present. Allelopathy may be involved in germination of new Artemisia seedlings. In the com-

pletely damaged area, Salsola populations have been dense and a new population of Artemisia seedlings have died. Grayia spinosa and to a lesser extent Eurotia lanata, Ephedra nevadensis, Tetradymia axillaris and Chrysothamnus nauseosus have successfully reestablished themselves. At the disturbed area around the Sedan crater only Atriplex canescens of the original perennial shrubs has germinated and survived. Some Lycium andersonii have survived near the crater (300 m away) with new growth sprouting from old crowns. Salsola iberica and Salsola paulsenii have been the principal plant species in this area since the event. There is evidence that browsing animals present could prevent recovery of shrubs in the area by eating any new seedlings which germinate or new shoots which sprout from old crowns. (auth)

45763 (TID-25954, pp 87-101) CHARACTERISTICS OF ARTEMISIA SPECIES (SAGEBRUSH). 1972.

In Radioecology and ecophysiology of desert plants at the Nevada Test Site.

The Artemisia species in general belong to the Great Basin Desert, and our soil temperature studies indicate that A. tridentata prefers cool soil temperatures (13 to 24°C) to hot soil (28 to 35°C). Optimum growth was obtained under controlled air and root temperature conditions of 24°C root temperature and 16°C air temperature. A. tridentata seeds readily germinate and under glasshouse conditions the roots of seedlings elongate at the rate of about 2.5 cm per day. Stem cuttings were easily rooted. A. tridentata in our Nevada Test Site study areas apparently live an average of about 30 years, but some individuals do live much longer, especially under optimum edaphic and moisture conditions. About one-third of the plants in the stand were dead but there are sufficient new seedlings present in the area to replace the old stand in 20 to 30 years if the same rate of new seedlings is maintained each year. Rabbits graze on new A. tridentata seedlings and this may be an important factor influencing seedling survival. Stands of A. tridentata use soil moisture sufficiently to curtail the growth of grasses. In areas in which the shrubs had been destroyed by irradiation from fallout debris, the first stage of revegetation was from grasses. However, new seedling development has occurred in these areas in more than sufficient amounts to reestablish the original stands of A. tridentata. Possibilities of allelopathy between the species present is of continued interest to us. A. tridentata appears to be sensitive to chlorides and to changes in soil pH. It is commonly found growing on calcareous soils, yet it grows well on non-calcareous soil. Low calcium levels of about 10^{-4} N in nutrient solution inhibited its growth. Field grown A. tridentata absorbs little sodium and it generally has lower phosphorus than many other shrub species. (auth)

45764 (TID-25954, pp 102-9) CHARACTERISTICS OF EPHEDRA SPECIES (MORON TEA). 1972.

In Radioecology and ecophysiology of desert plants at the Nevada Test Site.

Four species of Ephedra occur at the Nevada Test Site and these separate into cold and hot desert species. Ephedra species grow slowly and in some years do not produce flowers or seeds. E. nevadensis has a clumping habit due to underground stolon production. Seedlings and cuttings of E. viridis and E. nevadensis were prepared and used for several studies. E. viridis grew somewhat better at a root temperature of 21°C than at either 28 or 16°C. Shoots of E. nevadensis do not accumulate sodium, are low in phosphorus and high in aluminum. Very young shoots are low in potassium and high in calcium in contrast to most plant species. Ephedra species are extremely sensitive to γ radiation. Cuttings of E. viridis were exposed to a ^{60}Co γ source and the LD_{100} dose from acute exposure was determined to be 3 kR. (C.H.)

45765 (TID-25954, pp 115-32) CHARACTERISTICS OF LARREA DIVARICATA (CREOSOTE BUSH). 1972.

In Radioecology and ecophysiology of desert plants at the Nevada Test Site.

Larrea divaricata is the most common shrub on a large portion of the Nevada Test Site. It is extremely drought resistant and well adapted for survival in the desert, reaching ages probably of well over 100 years. Shoots continually die and new ones arise from the crown. Leaves are functional at relatively low water contents. Germination of seed occurs under relatively warm and moist conditions, but survival is rare. Rapid depth of rooting is one of its survival mechanisms. It branches laterally and occupies much of the soil not covered by other shrubs. It responds to summer rains and may set seed a second time in one year. Limiting factors for its growth under natural conditions include water and mineral nitrogen. Good soil aeration is necessary and it does not spread into areas where water stands for periods of time. It is widely spaced but is in clumps with other species and does not seem to compete with itself by chemical means. Spacing can be random, clumped, or regular. Being a hot desert species, it prefers warm to hot soil; but is not completely dormant during the winter season when air temperatures drop below freezing. It can be injured by frost but can recover. It is adapted to a wide range of soil pH even though it is native to calcareous areas high in pH and seems to prefer calcareous soil. Its mineral analysis revealed that it is low in zinc and copper when grown in calcareous soil. It tends to exclude sodium and tolerates little of it. It responds vigorously to severe pruning, but in the first season flowering was decreased by pruning. Ecotypes contribute to its variability. Rooted cuttings were made from one-year-old seedlings, but not from much older plants. Adventitious shoots grow from old severed roots. One-year-old L. divaricata wood is used for food by jackrabbits. L. divaricata is more resistant to ionizing radiation than are many other species. (auth)

45766 (TID-25954, pp 133-46) CHARACTERISTICS OF LYCIUM SPECIES. 1972.

In Radioecology and ecophysiology of desert plants at the Nevada Test Site.

Lycium andersonii, Lycium pallidum, and Lycium shockleyi appear to have different soil requirements. Lycium species are winter dormant and leafless because of extremes in soil moisture and soil temperature. Adventitious shoots form on roots of L. andersonii and cuttings of this species root readily. Seedlings of L. andersonii and L. pallidum germinate readily in the glasshouse when viable seed is obtained. Cuttings of L. pallidum seedlings have rooted; but some individual plants have been propagated by layering. Glasshouse-grown leaves of L. andersonii and L. pallidum are much different from those grown in the field. The ease of leaf drop in L. andersonii may be a survival mechanism. Shoots of rooted cuttings of L. andersonii grow several feet in a single flush in the glasshouse compared with a few cm in the field. L. pallidum grows poorly in the glasshouse unless soil temperature is low, at least initially. Growth of L. pallidum appears to be dependent upon soil temperature while L. andersonii does not. The mineral composition of L. andersonii is characterized by high calcium and potassium and low sodium and zinc contents. L. pallidum and L. shockleyi have lower calcium and potassium and higher sodium contents than L. andersonii. Lycium species appear to accumulate lithium. L. andersonii appears to have a low phosphorus requirement. L. andersonii is highly sensitive to ionizing radiation in relation to other shrub plant species found at the Nevada Test Site and it has a high nuclear volume. Grafting compatibility occurs between L. andersonii and L. pallidum. (auth)

45767 (TID-25954, pp 147-52) CHARACTERISTICS OF SALSOLA SPECIES. 1972.

In Radioecology and ecophysiology of desert plants at the Nevada Test Site.

Salsola species (commonly known as tumbleweed or Russian thistle)) are abundant at the Nevada Test Site, especially where soil has been disturbed or where the native vegetation has been killed which results in a more favorable water balance. The species appear to have several adaptive mechanisms which result in its survival under arid conditions. These include rapid germination and penetration into soil, increased resistance to water loss through transpiration as soil temperature increases, and high photosynthetic efficiency through the C-4 dicarboxylic fixation pathway. Salsola is very resistant to ionizing radiation. Exposure of seeds to up to about 60 kR from a ^{60}Co γ source resulted in no apparent effect on germination or growth of the seedlings. Exposure to between 60 and 400 kR resulted in germination and elongation of shoots and roots to a certain limit only. Exposures above 500 kR resulted in progressively less elongation and in death of seedlings. The first response curve obviously relates to cell division. The implication is that the seed contains the fully differentiated seedling which grows by cell elongation when exposed to water at the proper temperature. No cell division is needed for this phase of growth; hence there is no effect of the radiation at levels which inhibit nucleic acid synthesis and function. (C.H.)

45768 (TID-25954, pp 153-61) CHARACTERISTICS OF FRANSERIA DUMOSA (BURRO BUSH OR BURR SAGE). 1972.

In Radioecology and ecophysiology of desert plants at the Nevada Test Site.

Franseria dumosa is a shrub which dominates or associates with Larrea divaricata at the Nevada Test Site. It is relatively short lived, compared with other shrubs. It is deciduous depending more upon soil moisture than on hot or cold temperatures. Late summer rains of sufficient magnitude cause it to resume growth, flower, and set seed, thus sometimes completing two productivity cycles in a given year. It sets fruits in any season of the year. Leaf drop under conditions of stress may be a survival mechanism under desert conditions. Root growth of

seedlings is extremely rapid. F. dumosa requires warm conditions for growth, especially warm soil and air temperature, and it is not found at high altitudes. Low soil temperature (11°C) greatly decreased growth. Freezing injured the vegetative growth. It is tolerant of a moderate degree of salinity and is relatively insensitive to soil pH. It accumulates large quantities of boron and of calcium. It is moderately resistant to ionizing radiation. Acute γ irradiation with 4 kR was lethal to F. dumosa. (auth)

45769 (TID-25954, pp 188-98) CHARACTERISTICS OF YUCCA SPECIES Y. SCHDIGERA, Y. BREVIFOLIA, AND Y. BACCATA. 1972.

In Radioecology and ecophysiology of desert plants at the Nevada Test Site.

Age of Yucca schidigera and Yucca brevifolia can be estimated reasonably well by either counting vascular bundle rings or by counting numbers of blades, or from measuring height. The first method requires sacrificing the plant. On plants sprayed with water-base paint to differentiate between previous and new year's growth, an average of 18 new leaf-blades in 3 sets of 6 normally developed each year for both species. More or less of these sets of leaves may develop in the unusually wet or dry years. There is some evidence that the Y. brevifolia population is advancing down the bajada onto the playa in Yucca Flat. These Yucca plants do not flower each year. Y. brevifolia is more tolerant of salt than is Y. schidigera and it absorbs less sodium-factors which may be involved in the natural distribution of these species. Both species of Yucca seedlings grew best at root temperatures near 18°C and without $CaCO_3$ in the soil. Acute levels of gamma radiation prior to a subsequent year of continued growth in soil resulted in a slight growth stimulation from 4 to 12 kR, followed by a suppression of growth as the dosage levels were increased to 36 kR. Gamma radiation treatments had great influence on the ion transport processes in these plants. (auth)

45770 SOME SPECIFIC QUESTIONS OF RADIATION MUTAGENESIS OF POTATO. Tarasenko, N. D. (Inst. of Cytology and Genetics, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, No. 5, Ser. Biol. Nauk; No. 1, 99-108(Apr 1971). (In Russian).

The results of the three year investigation of variability and heritability of productivity, starch, and raw protein contents of potato are given. Phenotypic correlations between the above mentioned features and genotypic correlations between productivity and starch content were determined. Genotypic correlations were higher than phenotypic ones. Some data are given showing the possibility of changing the correlations between the bulb size and starch content under the influence of gamma-rays and fast neutrons in a series of mutants as compared to the initial varieties, as well as the possibility of experimental dechimerization of genetically chimeric varieties by means of radiation. (auth)

45771 RECESSIVE GENES PRODUCING ALBINO AND LIGHT GREEN SEEDLINGS IN SUGI, CRYPTOMERIA JAPONICA D. DON. Ohba, Kihachiro (Inst. of Radiation Breeding, Omiya, Japan); Murai, Masafumi. Nippon Rin Gakkai-Shi; 53: No. 6, 177-80 (Jun 1971). (In Japanese).

Out of commercial sugi (Japanese cedar) saplings planted in the gamma field of the Institute of Radiation Breeding in 1962, four heterozygous saplings for a recessive albino gene, two heterozygous saplings for a recessive gene producing light green or yellowish green seedlings, and one doubly heterozygous sapling for both genes were found. The recessive homozygotes are lethal soon after germination under natural conditions. These recessive genes were not expected to be produced by gamma ray irradiation, and they could have been transmitted to the progeny from the heterozygous mother trees from which commercial seeds were collected. After two years' crossing experiments including selfing with gibberellin-induced flowers, it was found that singly heterozygous saplings segregated the seedlings in the ratio of normal vs albino or light green as 3:1. Meanwhile, one doubly heterozygous sapling segregated normal vs albino vs light green as 9:4:3, because albinism has an epistatic effect on the light green. No allelic relation was proved between the recessive gene responsible for light green seedlings and other recessive genes which produce light green seedlings in a sugi individual and two cultivars, namely, G-5, Kumotoosi and Kuma-sugi, respectively. (auth) (Japan)

45772 CYSTEIN PROTECTION AGAINST ETHYLENIMINE DAMAGE IN BARLEY SEEDS. Kaul, B. L.; Choudhary, D. K. (Regional Research Lab., Jammu-Tawi, India). Radiat. Bot.; 12: No. 2, 57-61(May 1972).

Experiments were performed to find out if cystein could provide protection against the toxic and mutagenic effects of EI, a monofunctional alkylating agent. Cystein was administered either pre or post EI treatment and in combination with it. It was found that in all three cases cystein provided a strong protection against EI damage. Protection was, however, maximum when both EI and cystein were administered in a mixture. It is pointed out that cystein being very sensitive to alkylation, mops up all of the excess of mutagen in post treatments and alkylates mol for mol in other treatments, thus, removing the excess of mutagen that otherwise would have acted detrimental to the cell, causing a host of physiological damages. (auth)

45773 INFLUENCE OF NEUTRON IRRADIATION ON SEED GERMINATION AND PLANT GROWTH OF TOMATOES. Rusu, F.; Luca, I.; Matei, V.; Savitchi, O. Lucr. Stiint. Inst. Agron. Ion Ionescu De La Brad, Iasi; 427-36(1970). (In Rumanian).

Experiments were carried out on tomato plants from seeds treated with different neutron doses, in dry or moist state. In the first stage, doses between 500 and 1500 rem were used to establish the neutron treatment. In the second stage the prolonged effect of the treatment applied in the first generation was studied. The conclusion was reached that 500 rem doses applied to moist seeds stimulate growth and development. The plants were more hardy and surpassed control plants by 1 to 2 stages of organogenesis. The positive effect was observed to be maintained also in second generations, as the nursery transplants obtained surpassed the control in growth and development. (Rom. Sci. Abstr.)

45774 GAMMA RADIATION-INDUCED CHANGES IN THE ANATOMIC STRUCTURE AND CHEMICAL COMPOSITION OF SPRUCE WOOD. Katkevich, Yu. Yu.; Odintsov, P. N.; Pendere, M. K. (Inst. of Wood Chemistry, Riga). Khim. Drev.; No. 5, 11-22(1970). (In Russian).

Spruce seedlings were irradiated with ^{60}Co gamma radiation during the vegetative period (60 to 14,700 R). That year and during the two following years at the end of the vegetative period the anatomical structure and the chemical composition were studied. Small doses evoked no changes; at 2,000 R (5 R/hr) the cambium completely ceased to divide. Radiation damage to cambium by doses greater than 1,000 R (at 0.3 R/hr) was still evident two years after irradiation. Tracheids forming during exposure to radiation were of small dimensions and irregular form, and the wood had low specific weight. Shifts in the ratios of the chemical components constituting the wood were observed. The synthesis of cellulose and lignin were the processes most sensitive to radiation; the formation of hemicellulose, and especially the polyuronides, was affected the least by radiation. (tr-auth)

45775 STUDIES OF INDUCED MUTATIONS IN PEAS. XXVI. GENETICALLY CONDITIONED DIFFERENCES IN RADIATION SENSITIVITY. 4. Blixt, Stig. Agri Hort. Genet.; 28: 55-116 (1970).

Four pea lines at three different levels of gamma-ray sensitivity were crossed, and the sensitivity of the lines in the F_1 and F_2-generations was studied. The criteria of radiation effect used have been the dose for fifty per cent germination inhibition (DRG 50), growth inhibition (DRE 50), survival of main shoot (DRP 50) and of main and secondary shoot (DRT 50), and the dose producing spotting degree 2.5 (DS 2.5). The characteristics studied in relation to sensitivity have been the number of recessive genes (NR and NR^A), flowering time (S–F) and the genes A, Cor, D, Di, F, Fs, Gri, I, Kp, Kpa, Le, Mifo, O, Pl, R, U and V. Of the four lines used, line 180 was the most radiation-resistant, the lines 1147 and 1241 the most radiation-sensitive, while line 1405 was intermediate. The F_1-generations showed that the different criteria used for measuring sensitivity probably reflected radiation effects on different mechanisms. Also, the different crosses differed with respect to sensitivity: crosses involving line 180 were generally more resistant than those not involving this line. Of these latter crosses, the crosses involving line 1405 were more resistant than the cross not involving it. The results indicate that the gene A is of the first importance in determining the sensitivity; recessivity for this gene results in a low level of resistance to gamma-radiation. In genotypes dominant or heterozygous for A, the sensitivity is influenced by the number of double-recessive genes present in the genotype. The results from the analysis of the F_2-generations showed a clear effect of the gene R in chromosome VII, genotypes recessive for this gene being more sensitive. Chromosome I was also found to be connected with sensitivity. Evidence seems to support the hypothesis that heterochromatic regions in these two chromosomes are involved in the gamma-sensitivity differences found in Pisum. Radiation sensitivity, its mechanisms and causes in micro-organisms and higher developed organisms, and the relation of these results to the results from Pisum are discussed. (auth)

45776 MUTATION GENETICS IN PISUM. Blixt, Stig. Agri Hort. Genet.; 30: 1-293(1972).

A review of the literature on the genetics of the genus Pisum is presented. Some topics reviewed are systematics, ontogeny, cytology, genetics, spontaneous mutations, induced mutations, chromosome aberrations, leaf aberrations, genetically conditioned

sensitivity of the M_1 generation, factors modifying the sensitivity of the M_1 generation, chimaerism, the mutation rate, the mutation spectrum, linkage relations of mutations, and the role of mutations in plant breeding. A correlation was found between toxic and mutagenic effects of ionizing radiation, and it was found that radiosensitivity was genotypically conditioned. (H.L.W.)

45777 RADIORECOVERY EFFECT OF YEAST EXTRACT ON CARNATION CUTTINGS (DIANTHUS CARYOPHYLLUS L., WHITE SIM) IRRADIATED WITH ^{60}Co γ RAYS. PRELIMINARY MORPHOLOGICAL STUDY. Fouletier, Bernadette; Brun, Therese; Jonard, Robert; Pereau-Leroy, Pierre (CEN de Cadarache, Saint-Paul-les-Durance, France. Univ., Montpellier, France). Compt. Rend., Ser. D; 274: No. 9, 1315-18(28 Feb 1972). (In French).

Yeast extract has a radiorecovery effect, and increases the percentage of white petals of White Sim carnations subjected to γ irradiation. These facts indicate that the recovery is due to a distribution of cells damaged at the epidermic cellular base that determines the characteristics of the white flower. The processes occurring are thus more involved than the simple recovery by compensation resulting from the less damaged underlying cells carrying the red flower characteristics, as is the case with spontaneous recovery. (France)

Radiation Effects on Animals (External Source)

Man

Refer also to abstracts: 45290, 45732, and 45911.

45778 (NP-tr-1941) RADIATION HAZARDS AND RADIATION PROTECTION. Hug, O. Translated by D. H. Garrett (State Electricity Commission of Victoria), from Atomwirt., Atomtech.; 16: No. 6, 294-300(Jun 1971). 17p. Dep. NTIS (U. S. Sales Only).

An unrealistic over-estimation of the hazards of exposure to radiations, that is no longer consistent with the findings of experience, can be just as harmful as the view that the risks are more or less a matter of chance. All forms of radiation associated with the operation of nuclear power plants must be strictly monitored. If the recommendations and existing regulations are correctly understood and properly applied in the practical measures for protection against radiation, according to the known facts the reduction of the threshold values to a tenth of those currently in force appears to be unnecessary. The intensity of the radiation corresponding to these values is appreciably lower than that of the dose equivalent from natural radiation sources. As the utilization of nuclear energy is unavoidably associated with certain radiation effects, not only on personnel employed in the various plants but also on large groups of the population, it is necessary to determine the ways in which the risk attendant on the different forms of radiation depends on the degree of exposure, and to ascertain the maximum permissible doses that are commensurate with the safety of the individual and of the community at large. The theoretical principles of the relative biological effectiveness of radiations are reviewed. Delayed manifestations of radiation injuries, particularly malignant diseases, are discussed. A critical evaluation of the maximum dosage currently accepted as permissible is presented. (auth)

45779 (TT-54002/4) POLISH REVIEW OF RADIOLOGY AND NUCLEAR MEDICINE. Bimonthly of the Polish Radiological Association, Warsaw, Poland. Translated Reprint of Pol. Przegl. Radiol. Med. Nukl.; 35: No. 4, (1971). 123p. NTIS.

Separate abstracts were prepared for seven of the 20 articles appearing in the journal. The other articles discuss radiographic finding in various diseases, and the effectiveness of various diagnostic procedures. (E.R.B.)

For abstracts of individual papers see: 45780-45784, 45906, and 45927.

45780 (TT-54002/4, pp 430-6) EVALUATION OF THE CAUSES OF FAILURES IN ROENTGENTHERAPY OF CARCINOMA OF THE LARYNX. Ulkowski, Miroslaw; Hartel-Ulkowska, Narcyza (Inst. of Radiology, Warsaw). Translated from Przegl. Radiol. Med. Nukl.; 35: No. 4, (1971).

Causes of failures in roentgentherapy of carcinoma of the larynx were analyzed. The main cause was late clinical stage and local advancement of the tumor. Another important cause, according to the authors, is connected with histological type of the tumor, namely anaplastic carcinoma. (auth)

45781 (TT-54002/4, pp 437-41) SELECTED PROGNOSTIC ELEMENTS IN CARCINOMA OF THE LARYNX. Swiatnicka, Jolanta; Heliniak, Andrzej; Vorbrodtowa, Janina; Godawski, Jerzy. Translated from Przegl. Radiol. Med. Nukl.; 35: No. 4, (1971).

On the basis of observations of 265 patients with carcinoma of the larynx treated with roentgen rays, the possibility of curing patients with T_3, N_1, N_2, immobilization of the vocal cords, edema of the laryngeal mucosa during treatment, and patients with late response to irradiation was evaluated. (auth)

45782 (TT-54002/4, pp 442-50) REMARKS ON LOCAL METASTASES TO LYMPH NODES IN TUMORS OF THE LARYNX, TONSILS, AND NASOPHARYNX AFTER X-RAY THERAPY. Borejko, Juliusz (Inst. of Radiology, Warsaw). Translated from Przegl. Radiol. Med. Nukl.; 35: No. 4, (1971).

Results of x-ray therapy of tumor metastases to the lymph nodes in carcinoma of the larynx (105 patients), tonsils (39 patients), and nasopharynx (23 patients) are discussed. For various reasons, these patients were not operated. The reactions of the lymph nodes to irradiation were divided into three groups: favorable, palliative, and unfavorable. In the group of favorable reactions, the chances of survival in all three groups according to anatomic localization were about 50%. Patients with palliative and unfavorable reactions had small chances of survival. A striking and statistically significant observation concerns the number of positive reactions in tumors of the tonsil and nasopharynx, compared with tumors of the larynx. (auth)

45783 (TT-54002/4, pp 451-5) PROGNOSTIC ELEMENTS IN INOPERABLE CARCINOMA OF THE BREAST. Hliniak, Andrzej; Wojcieszek, Zbigniew; Slomska, Janina; Petryna, Alicja; Godawski, Jerzy (Inst. of Oncology, Gliwice, Poland). Translated from Przegl. Radiol. Med. Nukl.; 35: No. 4, (1971).

On the basis of observations on 569 women with inoperable carcinoma of the breast treated with x rays in the years 1951 to 1963, the prognostic significance of the length of clinical history and the "T" and "N" characteristics of the tumor was analyzed. (auth)

45784 (TT-54002/4, pp 456-61) DISTRIBUTION OF DOSES IN THE LESSER PELVIS IN THE TREATMENT OF CARCINOMA OF THE CERVIX UTERI. CALCULATION OF DOSES FROM RADIUM APPLICATORS AT SELECTED POINTS OF THE LESSER PELVIS. Szymczyk, Wieslawa; Siuda, Jerzy; Medvey, Wojciech; Polak, Bogumil; Polok, Bogdan (Inst. of Oncology, Cracow). Translated from Przegl. Radiol. Med. Nukl.; 35: No. 4, (1971).

A graphic and an analytical method of determination of the coordinates of points A are presented. It was assumed that the points and the first container of the uterine probe lie in a plane vertical to the sagittal plane. The points corresponding to the position of the obturator lymph nodes were referred to the skeleton (point "O"). Calculations were carried out on 90 patients. The error in the evaluation of doses in points A is calculated at ±8%, in points 0 at ±5%. The radiation absorption in the tissues was taken into consideration. (auth)

45785 (TT-54002/5) POLISH REVIEW OF RADIOLOGY AND NUCLEAR MEDICINE. Bimonthly of the Polish Radiological Association, Warsaw, Poland. Translated Reprint of Pol. Przegl. Radiol. Med. Nukl.; 35: No. 5, (1971). 138p. NTIS.

Separate abstracts were prepared for two of the 22 papers appearing in the journal. The other papers discuss radiologic techniques and the effectiveness of various radiotherapeutic methods. (E.R.B.)

For abstracts of individual papers see: 45786 and 45787.

45786 (TT-54002/5, pp 590-3) DISTRIBUTION OF DOSES IN PATIENTS WITH HODGKIN'S DISEASE DURING CONVENTIONAL RADIOTHERAPY. Glinska, Halina; Skolyszewski, Jan (Inst. of Oncology, Cracow). Translated from Pol. Przegl. Radiol. Med. Nukl.; 35: No. 5, (1971).

The differences between the measured and planned doses in both areas examined depend on the physical properties of radiation incited by a voltage of 200 to 250 kV, and technical conditions of therapy. Tables of doses and diagrams of isodoses, on the basis of which therapy is planned, are based on results of measurements made under model conditions, differing from clinical practice. When irradiating the mediastinum, the most important cause of the difference is the increased absorption of radiation by the bones of the vertebral column, ribs, and sternum. The difference in the dose between the central and peripheral parts of the irradiated tissue block is a result mainly of a smaller contribution of dispersed radiation in the marginal part of the beam. When irradiating the cervico-supraclavicular area, the main factor is connected with the irregular shape of the tissue block and consequently insufficient contribution of the dispersed dose. From the clinical point of view, these phenomena are clearly unfavorable, constituting an obstacle to application of a uniform dose to the whole irradiated area. Since the results of roentgentherapy in malignant lymphogranulomatosis characteristically depend on the magnitude of dosage, development of a method permitting better distribution of doses should have a favorable effect on the therapeutic results.

Megavolt therapy offers such a possibility. The observed discrepancies between actual and planned doses were sometimes as high as 30%. Hence, therapy must be guided in a large degree by evaluation of the patient's clinical state, and not only by the nominal dosage. Individualization of therapy taking into account the intensity of the reaction to radiation and regression of the tumor is an important factor. (auth)

45787 (TT-54002/5, pp 602-4) TRIAL OF CORRELATING THE BLOOD PICTURE WITH ABSORBED DOSES IN PERSONS EXPOSED PROFESSIONALLY TO IONIZING RADIATION. Lobodziec, Wlodzimierz; Pinkwart, Harry; Czaplewski, Stanislaw (Inst. of Oncology, Gliwice, Poland). Translated from Pol. Przegl. Radiol. Med. Nukl.; 35: No. 5, (1971).

Analysis of the data does not show correlation between the blood pictures and doses absorbed individually. In the range from 0 to 20 rems absorbed during 7 yrs, progressive deterioration of the blood picture was not observed. We are aware that the material of 98 persons is too small for statistical conclusions; however, the doses lie within the limits of annual permissible absorption. In spite of the small material, the long period of observation of over 7 yrs justified the analysis. A similar analysis in institutions employing a larger number of personnel exposed to ionizing radiation would be interesting. The data indicate that in personnel exposed to doses not exceeding the permissible annual norms, or only sporadically in some months, the blood picture is not impaired proportionally to the individual doses absorbed. (auth)

45788 ESTIMATION OF SULPHUR CONTENT IN HUMAN HAIR AND NAIL FOR USE IN FAST NEUTRON DOSIMETRY. Amin, S. R.; Gupta, B. L. (Bhabha Atomic Research Centre, Bombay). Health Phys.; 23: No. 2, 243-4(Aug 1972).

Sulfur activation in hair and nail has been used for the evaluation of the fast neutron dose received by persons involved in criticality accidents, by measuring the beta activity arising from the $^{32}S(n, p)$ ^{32}P reaction. Work reported here was undertaken to investigate whether the sulfur content in hair shows any dependence on age, sex, or food habits. An increase was found with age up to 35 and then a decrease. The content was found to be higher in non-vegetarians than in vegetarians, and male hair content was higher than female. Some variations between the content were found in people of different races. In view of these divergences in values it is thought that the possible variation of sulfur content should be considered when fast neutron doses are evaluated from sulfur activation in hair. (UK)

45789 QUANTITIES FOR THE DESCRIPTION OF NEUTRON IRRADIATIONS OF MAN. A LOOK AT THE MECHANISM OF OVER-CONSERVATISM. Pretre, S. (Research Inst. for Protective Construction, Zurich). Health Phys.; 23: No. 2, 169-81 (Aug 1972).

The conversion from neutron fluence into either absorbed dose or dose equivalent is discussed. It is shown that the quality factor can have four different meanings which should be separated properly from each other. It is proposed to distinguish between conservative quantities which are used for preventive purposes (radiation protection) and which refer to late somatic and genetic effects of chronic exposures at low dose-rate (conditions within ICRP limits), and realistic quantities which are used to estimate the actual damage (radiation accidents, radiotherapy, civil defense, animal experiments) and which refer to early somatic effects of an acute exposure at high dose-rate (conditions mostly beyond ICRP limits). This distinction is urgently needed, particularly in the case of dose-equivalent, because the unit "rem" is not unequivocally defined. There are in fact two different "rem", one of them being the old but realistic "Röntgen Equivalent Man", while the newer one includes comparatively more conservatism. Among the many interactions neutrons can undergo in tissue, the capture $H(n,\gamma)D$ is of great importance to man, due to the large dimensions of his body. Therefore, a substantial part of any neutron dose is absorbed by man in the form of a gamma dose. With this in mind, it is felt that the internationally recommended quality factors for neutrons are generally too high. The question is raised why the protection against neutrons is more conservative than the protection against gamma quanta. (auth)

45790 ASPECTS OF RADIATION CONTROL FOR CLINICAL IMPLANTS OF ^{252}Cf. Oliver, G. D. Jr. (Anderson Hospital and Tumor Inst., Houston, Tex.). Health Phys.; 23: No. 2, 187-92(Aug 1972). (CONF-710710-12).

From 16th annual Health Physics Society meeting; New York, N. Y. (12 Jul 1971).

The safe use of neutron-emitting isotopes, such as ^{252}Cf for interstitial and intracavitary radiotherapy, raises new problems of radiation protection in a hospital. Techniques associated with conventional radiotherapy sources have been adapted for the neutron sources. The use of source afterloading reduces the dose to personnel by eliminating source handling in sterilization procedures and in the surgical theater. In addition, the time required for source manipulation into implants can be minimized by using specialized instruments. Doses to nurses involved in routine care of the implanted patient can be at an acceptable level if a portable barrier is utilized when possible and if special training and practice are conducted. Based on these approaches, the use of californium has proven feasible in the treatment of more than 20 neoplastic lesions of patients. The maximum probable dose received by radiotherapists has been 1.1 mrem per microgram of ^{252}Cf implanted in regions of the head and neck, skin, and pelvis. Each attending nurse is estimated to have received 2 mrem per microgram implanted. (auth)

45791 RADIATION ACCIDENTS IN UNIVERSITY LABORATORIES. Hughes, D. Accident Anal. Prev. (Elmsford, N. Y.); 2: No. 1, 29-34(May 1970).

Details are presented of 10 accidents that occurred at the University of Leeds during the period 1958 to 1968, involving radioactive substances (^{60}Co and tritium-labelled substances) or electrical machine sources of ionizing radiation. The University does not operate a reactor and most radiation work is performed with radioactive substances in tracer amounts, two gamma-ray irradiation facilities, 40 crystallographic x-ray sets, and a Van de Graaff generator. For each case described, appropriate safety measures to prevent repetition are indicated. (Occup. Safety and Health Abstr.)

45792 EFFECTS OF AGE AND RADIATION EXPOSURE ON CHROMOSOMES IN A MARSHALL ISLAND POPULATION. Demoise, Charles F. (Microbiological Associates, Inc., Bethesda, Md.).; Conard, Robert A. J. Gerontol.; 27: No. 2, 197-201(Apr 1972).

The effects of aging and long-term radiation exposure on chromosome counts in cultured peripheral blood lymphocytes and the influence of plasma from irradiated subjects were tested in a Marshall Island population. Both hypodiploid and polyploid levels were found to be related to the patients' age. Females over 50 years of age and older previously exposed males had approximately 1.5 times as many hypodiploid cells as did the younger subjects, while polyploid levels were sharply reduced in all subjects over 50 years. Radiation was also found to affect hypodiploid levels. This was most pronounced in the males where those exposed had 2.8 times as many hypodiploid cells as the unexposed. Similarly, radiated females had 1.3 times as many hypodiploid cells as the unexposed. No relationship was found between polyploid level and radiation. Both sex and chromosome size appeared implicated as possible factors contributing to hypodiploid levels. In all subjects, regardless of sex or exposure to fallout radiation, the largest and most frequent loss of chromosomes occurred in the G(Y) group (2.3 times the expected loss). In the C(X) chromosome group the females lost 15.2% more chromosomes than expected, and the males lost 12.6% fewer than predicted. No apparent sex or radiation effect occurred in the other five chromosome groups. A series of additional cultures indicated the presence of a chromosome breakage factor in the plasma from exposed subjects. Although chromosome aberrations were nearly doubled in cultures containing the exposed plasma, aneuploid levels were not affected. (auth)

45793 ACNEFORM CHANGES IN AREAS OF COBALT IRRADIATION. Trunnell, Thomas N.; Baer, Rudolf L.; Michaelides, Paraskevas (New York Univ., N. Y. Veterans Administration Hospital, New York). Arch. Dermatol.; 106: No. 1, 73-5(Jul 1972).

Two patients developed an acneform eruption in skin areas on the trunk. Both patients had received γ radiation through the involved skin areas for treatment of internal tumors. The cutaneous changes in both cases responded to conventional therapy for acne. (auth)

45794 CHROMOSOME ABERRATIONS IN HUMAN BONE-MARROW CELLS AFTER A SINGLE LOCAL GAMMA-IRRADIATION. I. STUDY OF TYPES AND FREQUENCIES OF ABERRATIONS IN DYNAMICS AFTER IRRADIATION AT DOSES OF 250 AND 500 RDS. Petrova, S. A.; Pyatkin, E. K.; Suskov, I. I.; Alexandrov, N. N.; Vorob'ev, A. I. (Research Inst. for Oncology and Medical Radiology, Minsk. Biophysical Inst., Moscow). Stud. Biophys.; 28: No. 3, 157-64(1971). (In Russian).

Direct chromosome studies of bone-marrow cells were made in a control group of 14 tumor patients and in a group of 88 patients at different intervals of time (1 to 168 hrs) after a single local irradiation with ^{60}Co gamma rays at doses of 250 and 500 rads. The highest frequency of aberrant cells was observed 18 and 21 hrs after irradiation with a dose of 250 rads and 24 hrs after irradiation with a dose of 500 rads. It was shown that following exposure to 250 rads the number of chromosome aberrations in cells entering mitosis soon after irradiation (apparently G_2 cells) was much

greater than that in cells entering mitosis in the subsequent periods. A sharp decrease in the number of aberrant cells and chromosome aberrations was observed 72 and 96 hrs after irradiations. (auth)

45795 AGE-SEX SPECIFIC ACHILLES TENDON REFLEX TIME IN JAPANESE: A STUDY OF ATOMIC BOMB SURVIVORS, HIROSHIMA. Omori, Yoshiaki (Atomic Bomb Casuality Commission, Hiroshima); Ashley, Frantz W.; Belsky, Joseph L. J. Chron. Dis.; 25: 111-20(1972).

Achilles tendon reflex in man was studied with the aid of photomotograph on 2100 (ages 18 to 89 yr) atomic bomb survivors and nonexposed controls of the Atomic Bomb Casualty Commission in Hiroshima to delineate effects of A-bomb radiation and aging. The reflex time was significantly prolonged, progressively, with age and it was more delayed in females than in males. The mean tap-to-half relaxation time was 290 ± 40 msec in males (mean age 46) and 321 ± 49 msec in females (mean age 46), which are similar to figures reported previously in Europe and the United States. In relation to radiation and obesity, no statistically significant difference in reflex time was found. These studies suggest that neurologic components of the reflex arc may be resistant to delayed effects of A-bomb radiation. Problems in interpreting reflex tracings and on differences in reflex time among races are discussed. Attention is called to age as an extrathyroidal factor in affecting achilles tendon reflex. (auth)

45796 RADIOBIOLOGICAL PROBLEMS CAUSED BY SUPERSONIC TRANSPORT. (WITH A SURVEY OF THE FIRST RESULTS ESTABLISHED BY TESTS PERFORMED ON BOARD THE CONCORDE PROTOTYPE). Delahaye, R. P.; Kaiser, R.; Pfister, A. (Nuclear Research Center, Strasbourg). Aerosp. Med.; 43: No. 7, 782-4(Jul 1972).

The present subsonic commercial aircraft flights do not present any major problems as far as radiobiology is concerned. The aircraft flying at altitudes higher than 15,000 m are subjected to irradiation which are different from those generally observed in the lower part of the atmosphere. A good many military pilots are already been subjected to this new environment. The entry in service of commercial supersonic transport aircraft (SST) will increase the number of exposed persons. At cruise altitudes (16,000 to 18,000) the screen constituted by terrestrial atmosphere and protecting the earth from cosmic radiation particles is considerably decreased, and it proved quite necessary to conduct a study on the possible radiobiological hazards sustained by SST passengers and crew. Results of radiation dose measurements made with nuclear emulsions and photographic film detectors located throughout the Concorde prototype are reported. (C.H.)

45797 RADIATION INJURY OF THE SPINAL CORD. Solheim, P. Oe. (Norske Radiumhospital, Oslo). Acta Radiol., Ther., Phys., Biol.; 10: No. 5, 474-80(Oct 1971).

Five cases of late radiation myelopathy are reported. Pareses and sensory disturbances progressed for some time after latent periods of from 5 to 19 months. Four of the five cases were then considerably improved. The clinical course of late radiation myelopathy thus seems not always to be chronic or progressive. (auth)

45798 IRRADIATION IN THE EPIDEMIOLOGY OF LEUKEMIA AMONG ADULTS. Gibson, R. (State Univ. of New York, Buffalo); Graham, S.; Lilienfeld, A.; (and others). J. Nat. Cancer Inst.; 48: No. 2, 301-11(Feb 1972).

The relation between leukemia and diagnostic medical irradiation was examined in 1,414 adult leukemia cases from Upstate New York and the Minneapolis and Baltimore metropolitan areas and 1,370 adult controls comprising a probability sample of the same areas from which the cases were drawn. Details of exposure by site and numbers of films were compiled from records of hospitals and physicians. The association of irradiation with leukemia was examined by the histologic type, sex, and age of the subject. Irradiation had an enhanced risk for males for both acute and chronic myeloid leukemia but not for females. The effect was more pronounced for irradiation to the trunk than to all other sites. Neither irradiated males nor females had an elevated risk for any other histologic type of leukemia. However, only a small proportion of the irradiated population develops leukemia, and irradiation accounts for only a small proportion of leukemia cases. (auth)

45799 CUMULATIVE DOSE FROM DIAGNOSTIC IRRADIATION. Norwood, W. D. (Hanford Environmental Health Foundation, Richland, Wash.); Rising, F. L.; Kirklin, C. W.; (and others). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 115: No. 3, 644-8(Jul 1972).

Using a relatively simple method, diagnostic exposures could be recorded as a unit indicating the dose in kilogram-rads, which is proportional to the total energy received by the tissue. Diagnostic doses could then be made additive with other such procedures involving different parts of the body and with therapeutic, occupational, or natural irradiation doses. Diagnostic roentgen-ray units might be compared and accounting methods used to indicate where reductions in exposures might be made optimally. The physician would be helped in his decision to order or not to order a diagnostic procedure by having knowledge of the patient's accumulated lifetime dose from radiation. The results of the study indicate that when appropriately averaged over the whole-body mass, the diagnostic exposures from medical roentgen rays are not as large relative to occupational whole-body exposures as previously believed. (auth)

45800 PULL-THROUGH OPERATION FOR RADIATION-INDUCED RECTOVAGINAL FISTULA. REPORT OF A CASE. Thomford, Neil R.; Smith, David E.; Wilson, Wayne H. (Ohio State Univ., Columbus). Dis. Colon Rectum; 13: No. 6, 451-3 (1970).

A patient in whom a large radiation-induced rectovaginal fistula was successfully repaired by a surgical operation is described. Normal bowel and vaginal function were restored. If repair of a rectovaginal fistula is indicated, and the fistula is large and located in the proximal vagina, the abdominal endorectal operation should be considered. (auth)

45801 HARD AND SOFT TISSUE NECROSES FOLLOWING RADIATION THERAPY FOR ORAL CANCER. Beumer III, John; Silverman, Sol Jr.; Benak, Steve B. (Univ. of California, San Francisco). J. Prosth. Dent.; 27: No. 6, 640-4(Jun 1972).

Three hundred and fifty-four patients, who underwent radiation therapy for oral cancer (excluding lip) at the University of California Medical Center at San Francisco between 1961 and 1969, were reviewed as to site of tumor, mode of therapy, tumor dose, and occurrence of tissue necrosis. The study group was limited to those 278 patients who were available for follow-up for at least 6 months. Osteonecrosis occurred in 3.6%: 8 of 141 dentulous patients (5.7%) and 2 of 137 edentulous patients (1.5%). All cases of bone necrosis occurred in the mandible and were within the treatment field. There were 18 cases (6.5%) of soft tissue necrosis. Eleven of these patients were treated by needle implantation or intraoral cone technique. Fifteen were self limited (5.2%). (auth)

45802 STENOSIS OF THE SMALL BOWEL AS A COMPLICATION IN RADIATION THERAPY OF CARCINOMA OF THE UTERINE CERVIX. Joelsson, I.; Raef, L.; Soederberg, G. (Karolinska Sjukhuset, Stockholm. Serafimerlasarettet, Stockholm). Acta Radiol., Ther., Phys., Biol.; 10: No. 6, 593-604 (Dec 1971).

Radiation-induced injury of the small bowel was observed in 15 of 3,075 cases from the Stockholm area, treated for carcinoma of the uterine cervix during 1954 to 1969. Factors that might increase the risk of this complication are discussed. Symptoms and signs of the intestinal complications are described and the results of surgical treatment presented. (auth)

45803 RADIATION PROTECTION CONSIDERED FROM THE MEDICAL VIEWPOINT. Ohlenschlaeger, L. Zentralbl. Arbeitsmed. Arbeitsschutz; 21: No. 9, 292-8(Sep 1971). (In German).

Following an introductory review of the interaction of ionizing radiation with irradiated material, and of the physical units adopted for radiation measurement, the author considers the maximum allowable doses fixed by German legislation and the medical supervision of persons occupationally exposed to radiation by means of clinical examinations and blood and urine analysis. He indicates a number of diseases disqualifying persons from work involving possible exposure to radiation. Particular attention is given to the problem of the medical supervision of personnel who are members of mobile teams employed in the maintenance and repair of nuclear reactors. (Occup. Saf. Health Abstr.)

45804 RADIOPROTECTION PRACTICE AT THE MARCOULE CENTER. Chassany, J. (Centre de Production du Plutonium de Marcoule, Bagnols-sur-Ceze, France). Rayonnements Ionis. Tech. Mes. Prot.; No. 3, 20-41(Jul 1971). (In French).

The Marcoule center consists of essentially four piles, a fuel reprocessing plant, their subsidiaries, a tritium extraction plant, and a plant for the reprocessing of irradiated fuels. A total of 2,078 personnel are employed, 1204 of which are directly concerned with work involving radiations. Fourteen years of experience have benefited various branches of study, the following being cited: development and improvements in efficiency of methods and means of protecting and controlling installations and personnel, environmental control, intervention, dosimetry, and protection of the respiratory tract. Experience demonstrates that the effectiveness of the means existing is very dependent upon the attitude of the individual and the psychological environment. (France)

45805 EFFECTS OF CEPHARANTHINE ON FLUCTUATION IN WHITE BLOOD CELL COUNT BY RADIOTHERAPY FOR GYNECOLOGIC CANCER. Ito, Haruhide; Hosaka, Koji; Toriumi, Tatsuo; Kubo, Sohei (Jikei Univ., Tokyo). Shinryo To Shinyaku; 8: No. 5, 191-4(May 1971). (In Japanese).

In the radiotherapy of malignant tumor, since a sufficient dose is expected, various side effects, especially hemopoietic hypofunction, appear in almost all cases and as its countermeasures, improvement of the procedure of radiation, blood transfusion, and administration of various drugs are being performed. Following a single administration of cepharanthine, marked effects were observed in 14 (70%) of the 20 cases. In particular, an effect was found in 13 (81.3%) of the 16 cases administered with 50 mg of cepharanthine. This indicates that the administration of 50 mg of cepharanthine has a far greater significance in the prevention of side effect than that of 10mg. Comparison of the group administered with cepharanthine with groups administered with other drugs revealed no significant difference, but this result included the administration of both 10mg and 50 mg, and more marked effect was observed in the group administered with 50 mg of cepharanthine than groups administered with other drugs. It is thought that the above results were obtained by the synergistic actions of reticuloendothelial hyperfunction and activation of the hemopoietic function of the bone marrow or liver function by cepharanthine on hemopoietic hypofunction particularly observed in the cancer-bearing organism. It was thought that leukocytopenia interfering with radiotherapy clinically could be avoided by the single administration of cepharanthine, especially the dose of 50mg. (Japan)

45806 SUPERSONIC RADIATION RISKS. Brit. Med. J.: 3: No. 5819, 130(15 Jul 1972).

Literature is briefly reviewed and editorial comment made on estimates of doses received by passengers in supersonic flights. A representative dose for passengers at 17,500 m is quoted as 0.6 to 1 mRem/hr and this is related to estimated doses of radiation received from other sources. The need for adequate solar flare detection is mentioned, and it is pointed out that in 1956 a flare gave a calculated dose rate of 2 rads/hr at 18,000 m. (UK)

45807 RADIATION MENOPAUSE. Doherty, R. Brit. Med. J.: 3: No. 5819, 176(15 Jul 1972).

A brief summary is made of a 1962 survey of the results of the use of radiation to induce menopause in female patients at the Plymouth Hospitals from 1948 to 1957. During this period 678 patients were treated with deep x-ray doses of between 850 and 900 rads, to the midpoint of the pelvis. Mention is made of side effects, effectiveness of treatment in inducing a menopause in dysfunctional bleeding, subsequent treatment, and later mortality. (UK)

45808 RADIATION PROTECTION MEASUREMENT. Kiefer, H.; Maushart, R. Oxford; Pergamon Press (1972). 577p.

Translated into English by R. Friese.

The subject is considered under the headings; introduction (development of radiation protection measurement techniques in the general field of radiation protection, radiation protection measurement in nuclear engineering, subdivision into special fields), dose determination, local dose monitoring, personal dose monitoring, activity determination (general remarks, measurement of activity in water, measurement of activity in air, measurement of activity in food and other biological substances, measurement external contamination, measurement of internal contamination), radionuclide determination survey of methods, physical methods; determination of the type of radiation, determination of half-life, determination of radiation energy, radiochemical methods, determination of specific radionuclides (tritium and low-energy β-emitters, iodine, radium and radon, uranium) measurements for the protection of the population (environmental survey of nuclear facilities, measurement after accidents in nuclear facilities, measurement in the case of a nuclear war) and trends in development (semiconductor detectors, problems of radiation measurement in space flight). (UK)

45809 HEPATIC INJURIES FOLLOWING IRRADIATION. Sakamoto, Yoshio; Kasuga, Toshio; Ohata, Takeo; Watanabe, Toshikazu; Nakanishi, Fumiko (Shinshu Univ., Nagano, Japan). Nippon Igaku Hoshasen Gakkai Zasshi; 30: No. 11, 120-30(Feb 1971). (In Japanese).

In the telecobalt therapy to malignant diseases of the neighboring organs of the liver, a part of the liver was often included in the irradiated fields, and hepatic changes were found in these irradiated areas. These hepatic changes were investigated by liver scanning, isotopic liver function tests, and liver histopathologic examination and the mechanism of radiation hepatitis was discussed. In the early period of hepatic irradiation, the function of liver parenchymal cells increased temporarily or congestion of liver acini around the central veins occurred in the irradiated areas, therefore liver blood flow increased. Gold-198 colloid liver scanning in this period suggested swelling of the liver in the irradiated area. When hepatic irradiation was continued or with the passing of time after completion of the irradiation, the liver blood flow decreased and the function of liver parenchymal cells, particularly of Kupffer's cells fell. As circulatory insufficiency of the liver following irradiation became severe, destruction and disappearance of the liver parenchymal cells and hemorrhage of liver acini began from the central portion of liver lobules and fibrosis surrounding central veins became remarkable. The reduction of photodensity in the irradiated area of the liver occurred in photoscintigram after irradiation less than 4,000 R or one month after beginning of radiation therapy. (auth)

45810 TISSUE MAST CELLS IN HUMAN BLOOD. PRELIMINARY REPORT. Csaba, G.; Hodinka, L.; Bozsoky, S.; Farkas, K. (Semmelweis Univ., Budapest. National Inst. of Rheumatology and Physiotherapy, Budapest). Haematologia (Budapest); 4: No. 3-4, 415-17(1970).

A total of 125 blood smears from 39 patients suffering from autoimmune diseases, degenerative processes of the locomotor system and tumors, and those of 10 healthy subjects were examined. Mast cells were counted in 1500 microscopic fields of each smear under 600-fold magnification. Mast cells were present in the blood of each examined subject, whether healthy or ill (98% of the cells were of lymphoid character and similar in size to the erythrocytes). In different diseases the blood mast cell count varied. The results showed an increase in the number of blood mast cells in autoimmune diseases involving the thymus, as compared to the controls or other subjects suffering from degenerative diseases. In contrast, in subjects with tumor the mast cell count displayed a decreasing trend. Mediastinal x irradiation, by affecting the thymus, was found to influence the blood mast cell count as well. The eventual diagnostic importance of the blood mast cell count is indicated by the findings. However, in order to evaluate correctly the shifts, further examinations of a large patient material are needed. (auth)

45811 WORKLOADS AND USE FACTORS IN DIAGNOSTIC X-RAY INSTALLATIONS. Campbell, E. M.; Essenburg, A.; Holloway, A. F. (Manitoba Cancer Treatment and Research Foundation, Winnipeg). Health Phys.; 23: No. 1, 67-71(Jul 1972).

A report is presented on the magnitude and distribution of workloads observed during the course of radiation surveys in diagnostic x-ray departments in hospitals in the Province of Manitoba. The data show that the magnitudes of the majority of these workloads were considerably lower than those quoted in tables relating to protective barrier requirements, and that the distribution of the primary beam workloads about an installation was such that suitable use factors deviated substantially from those recommended in the NCRP Report No. 34 and the Report of the Medical X-Ray Advisory Committee on Public Health Considerations in Medical Diagnostic Radiology (X-Rays). (auth)

45812 RADIATION HAZARDS TO MAN IN SPACEFLIGHTS. Allkofer, Otto Claus; Heinrich, Wolfgang; Simon, Manfred (Univ., Kiel). Umschau; 72: No. 9, 284-7(May 1972). (In German).

The radiation hazards to astronauts in manned space flights by cosmic radiation are surveyed. In a short review the fundamental facts are reviewed and the basic principles of dosimetric units are described. The radiation effects due to the different components of cosmic radiation are discussed showing that the galactic and solar radiation, and the radiation belts are contributing in a different manner to the radiation hazards. Although the abundance of the heavy ions is relatively small, the radiation effects have to be evaluated separately due to the high ionization along the particle tracks. The possible radiation injuries are enumerated. (auth)

Vertebrates

Refer also to abstract: 45733.

45813 (COO-1427-41) CELLULAR PROLIFERATION AND REGENERATION FOLLOWING TISSUE DAMAGE. Harding, Clifford V. (Oakland Univ., Rochester, Mich. Dept. of Biological Sciences). Feb 1972. Contract AT(11-1)-1427. 31p. Dep. NTIS.

Results obtained during the past seven year period on radiation effects on eyes of rabbits, are summarized. Mechanical injury to the lens, in vivo, initiates the cell cycle and is accompanied by propagated waves of DNA synthesis and mitosis that move out slowly from the site of injury. The injury response, and the effect of x irradiation on the propagated injury response and wound healing was determined. Biochemical and microscopic methods used in the studies are described. A determination of the in vitro culture conditions that bring about a reproducible stimulation of DNA syn-

thesis and mitosis in the cultured mammalian lens was accomplished. It was found that the lens in culture provides an excellent model system for studies on the response of tissue to injury under carefully controlled and defined conditions. (TSS)

45814 (COO-3017-43) RADIATION CARCINOGENESIS. Progress Report VI, May 1, 1971-April 30, 1972. Warren, Shields; Gates, Olive (New England Deaconess Hospital, Boston, Mass. Cancer Research Inst.). 30 Apr 1972. Contract AT(11-1)-3017. 29p. Dep. NTIS.

Investigations have been continued during this period on the following projects: Studies of the extraordinarily high incidence of cancer, including cancer developing in unusual sites, in supralethally irradiated parabiont rats. The incidence has continued appreciably higher than in single rats irradiated at a less degree. One unusual tumor developed is the sarcoma that appears in the anastomotic line. Detailed studies of this tumor have been carried out in the course of the year. Special studies have been made of the induction of osteogenic sarcoma and uterine carcinoma in parabiont and single rats using focal internal radiation from ^{60}Co γ sources. Pathologic and pathophysiologic studies of the transplantable pheochromocytoma mentioned last year are continuing. Studies on the effects of perinatal radiation on mice so far as induction of leukemia and solid tumors is concerned. Variation in strain and life period of radiation produce important differences in the neoplastic response. Study of the mice intensively inbred for a number of generations following radiation. Completion of the study of disordered calcium metabolism mentioned in the last report. (auth)

45815 (COO-3486-1) EFFECTS OF IONIZING RADIATION ON SALAMANDER ORIENTATION. Progress Report. Shoop, C. Robert (Rhode Island Univ., Kingston (USA). Inst. of Environmental Biology). 1 May 1972. Contract AT(11-1)-3486. 19p. Dep. NTIS.

Two species of salamanders, Ambystoma malculatum and A. opacum, were used in field studies in western Rhode Island. Ionizing radiation was administered to males for studies on effects of radiation on migration. Effects of gamma radiation on salamanders and other amphibians were investigated with regard to species differences, temperature effects, and dose rate effects. No increase in death rate occurred over a period of one year with doses of 25 to 50 Rad. It was found that radioresistance corresponds inversely to relative liver-cell nuclear DNA levels of the species involved. Studies on migration of females were conducted using ^{181}Ta and ^{182}Ta tags; determination of dose from the tags varied with placement of dosimeters in the body. Studies were conducted on uptake and turnover of radioactive sodium, cesium, praseodymium, and europium by larval and hatchling amphibians and reptiles. (H.L.W.)

45816 (FRNC-R-7) BIOLOGICAL EFFECTS OF THE INTENSITY OF IRRADIATION. Legeay (Laboratoire Central de l'Armement, Arcueil (France)). 17 Dec 1971. 58p. (In French). Dep. NTIS (U. S. Sales Only).

The biological effects of the time distribution of the absorbed energy, i.e. the intensity of irradiation, were investigated in various mammals. Before studying the recovery from a total and continuous irradiation, the radiosensitivity of various mammals (such as mice, rats, dogs, monkeys, guinea pigs, sheep, donkeys) was determined by measuring their mean lethal doses. The effects of the intensity of irradiation for low and high LET radiations were evaluated. The information obtained on cell and tissue recovery kinetics is summarized. Recovery models are proposed. The effects of the intensity of irradiation are estimated. (France)

45817 (ORO-2690-12(Pt.B), Paper 12) STUDIES IN THE USES OF IONIZING RADIATIONS AS STIMULI. Smith, James C. 1p.

Progress is reported on studies on conditions under which gamma rays can be used as stimuli to elicit reactions in a variety of animals. The role of visual gamma ray detection in rats and monkeys was studied and it was found that gamma ray detection is possible in dark adapted animals when they have been deprived of the sense of smell. It was demonstrated that gamma rays acted as aversive stimuli when paired with a novel taste solution; aversion of that solution resulted. Comparisons were made of necessary conditions for developing aversions when using gamma rays and lithium chloride. The development of aversions was studied by a computer analysis of licking behavior. (H.L.W.)

45818 (UCLA-12-867) IRRADIATION AND VIRAL LYMPHOMAGENESIS IN THYMIC GRAFTS. Haye, Esther F. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology). 1971. Contract AT(04-1)-Gen-12. 19p. Dep. NTIS.

The thymus of AKR neonatal mice was subjected to 850 and 5000 R ^{60}Co irradiation in vivo prior to its removal for grafting to thymectomized syngeneic hosts. These irradiated grafts placed in hosts inoculated as sucklings with Gross murine leukemia virus (GMuLV) developed lymphoma. The incidence was slightly lower and the latent period longer than that found in irradiated control grafts in similar hosts. When grafts were exposed to GMuLV in vitro just prior to grafting or in vivo 24 hr before grafting, but placed in hosts not given neonatal virus inoculation, lymphoma developed with reduced incidence in the 850 R irradiated grafts and did not develop in the grafts receiving 5000 R. A dose of 5000 R was not found to alter the lymphomagenic properties of filtrates containing GMuLV. These studies show that heavily irradiated thymic grafts can develop lymphoma in virus infected hosts, but that irradiation of grafts exposed to virus in vitro and in vivo inhibits the ability of GMuLV to produce lymphoma probably by reducing the numbers of cells available for virus replication, thus, indirectly lowering virus concentration in the thymic grafts. (auth)

45819 (UR-3490-63) IONIZING RADIATION-INDUCED THYROID CARCINOGENESIS IN THE DOG. Michaelson, S. M.; Lu, Shin-tsu; Quinlan, W. J. Jr. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). [nd]. 16p. (CONF-720505-3). Dep. NTIS.

From twelfth Hanford biology symposium on radionuclide carcinogenesis; Richland, WA. (11 May 1972).

The response of the thyroid gland of the dog to x ray or ^{131}I, either one alone or in combination, manifests itself in a temporal manner, functionally, by transient increased activity and progressive hypothyroidism and pathologically, by degeneration, hyperplasia, and carcinogenesis. Eleven cases of thyroid tumor were observed among 23 dogs that received external, internal radiation, or both survived 3 yr post exposure. One of four dogs received ^{131}I alone revealed bilateral follicular adenocarcinoma with anaplastic changes. This animal received ^{131}I in doses ranging from 17 to 50 μCi over a 5 yr-period. The calculated radiation exposure was 1580 rads. The animal died at age 13 yr 10 months or 5 yr 8 months after the initial dose of ^{131}I. Radioiodine uptake was markedly depressed corresponding to the non-differentiated nature of the neoplasm. The functional and histopathologic data on this dog is compared with other dogs that received either ^{131}I and/or x ray. Two of three dogs exposed to x irradiation alone had follicular adenoma and eight of 16 dogs that received ^{131}I in addition to x irradiation showed various types of thyroid tumors. The thyroid gland neoplasia seems to be more related to aging than to the onset of puberty as observed in man. Vascular alteration may initiate and amplify the visible and functional thyroid derangement. Increase in circulating TSH appears to be a basic factor in the sequence of events leading to permanent hyperplasia or carcinogenesis. The post-irradiation latency for induction of thyroid neoplasia in the dog (4 to 10 yr), man (9 to 14 yr), and the rat (1 to 2 yr) shows a linear relationship with basal metabolic rate. Although this relationship may be only fortuitous, it may be indicative of a fundamental factor related to tissue metabolism and/or thyroid cell turnover rate. (auth)

45820 (UR-3490-121) EFFECT OF RAT TUMOR ALLOGRAFTS ON THE DISTRIBUTION OF PASSIVELY TRANSFERRED ALLOANTIBODIES STUDIED BY HEMAGGLUTINATION AND ISOTOPIC TRACER TECHNIQUES. Buchsbaum, Donald Jay (Rochester Univ., N. Y.). 1972. 110p. Dep. NTIS.
Thesis.

The experimental studies reported here are concerned with transplantation antibodies produced in Buffalo strain rats following immunization with a tumor induced in a Fischer strain rat with methylcholanthrene. It is shown, with a hemagglutination technique for antibody titration, that when such antibodies are passively transferred to immunosuppressed Buffalo rats carrying this same Fischer tumor, the antibody titer in the blood declines more rapidly than in control Buffalo rats not carrying the tumor. A method was developed for obtaining radiolabeled transplantation antibody from immune Buffalo gamma globulin. When this labeled antibody was injected into Buffalo rats carrying the Fischer tumor, substantial preferential localization of radioactivity occurred in the tumor. With a few exceptions, serum taken from x ray and cortisone treated Buffalo rats bearing the Fischer tumor had hemagglutination titers lower by a factor of four or more than serum from control rats without tumors 3 or 4 days after immune Buffalo gamma globulin injection. Serum samples taken from tumor and control rats 6 hrs after injection appeared to have the same antibody titers. Radiolabeled transplantation antibodies were isolated from immune Buffalo gamma globulin by a twice repeated adsorption-elution procedure starting with Fischer red blood cells. The percentage of ^{125}I-antibody and ^{131}I-normal Buffalo gamma globulin present in eight growing

tumors 48 hrs after injection of the paired label mixture ranged from 1.6 to 9.3% and 0.4 to 1.1%, respectively. In general, the lower ^{125}I values were obtained with tumors weighing less than 0.4 grams, whereas the values were greater than 6% for tumors weighing 0.9 to 1.6 grams. The corresponding values for four growing tumors 96 hrs after injection were 1.9 to 4.0% and 0.3 to 1.5%. The average ratio of the fraction of the injected dose of antibody and normal gamma globulin was approximately one in all tissues except tumor, where the ^{125}I was more abundant by a factor of eight, 48 hrs after injection; and by a factor of six, 96 hrs after injection. (auth)

45821 CHOLERHEIC ENTEROPATHY AS A CAUSE OF DIARRHEA AND DEATH IN RADIATION ENTERITIS AND ITS PREVENTION WITH CHOLESTYRAMINE. Berk, Robert N.; Seay, David G. (Univ. of California, La Jolla, San Diego). Radiology; 104: No. 1, 153-6(Jul 1972).

Cholerheic enteropathy, a syndrome of diarrhea due to the effects of excessive bile salts in the colon, occurs when bile salt absorption from the terminal ileum is impaired. Cholestyramine, a nonabsorbable anion-exchange resin, prevents diarrhea by binding the bile salts, thus rendering them inactive. Evidence that cholerheic enteropathy has a significant role in the pathogenesis of diarrhea and death from radiation enteritis is reviewed, and experiments with rats treated with cholestyramine prior to abdominal irradiation are described. (auth)

45822 LYMPHOID-CELL RENEWAL UNDER LOW-LEVEL IRRADIATION. XI. THE CELL CYCLE AND GROWTH KINETICS DURING RADIATION LEUKEMOGENESIS IN C57BL MICE. Fabrikant, Jacob I.; Foster, Bessie R. (Univ. of Connecticut, Hartford). Radiology; 104: No. 1, 203-4(Jul 1972).

Studies of thymus-cell population kinetics suggest that during leukemogenesis, changes in the control of cell growth and division occur in cells undergoing differentiation and in those that are functionally mature as well as in proliferating cells, thus disturbing the rate of cell flux and transition from one phase of cell maturation to another. Progressive breakdown of cellular control mechanisms may be involved. Cell and tissue kinetics in the thymus are described in relation to the changing pattern of the lymphoid-cell cycle and growth fraction during the development of radiation-induced murine thymic lymphoma and disseminated leukemia. (auth)

45823 EFFECT OF RADIOPROTECTIVE PREPARATIONS ON THE RESPIRATORY EXCHANGE OF RATS. Novak, L.; Fedorov, B. A.; Gosek, B.; Semenov, L. F. (Inst. of Experimental Pathology and Therapeutics, Sukhumi, USSR. Inst. for Biophysics, Brno). Radiobiol.-Radiother.; 12: No. 6, 751-6(1971). (In German).

In experiments with 72 unirradiated white rats the influence of thiol-radioprotectors (cystamine, MEA, thiocarbamide, acetylcholine) on the adaptive respiratory exchange was examined and measured over the course of three hours. The sulfur preparations did not cause a decreased consumption of oxygen. Adrenaline and acetylcholine increased the consumption of O_2; indolylalkylamines decreased it. Histamine did not affect the respiratory exchange. The effect of the protectors is not caused by their influence on the oxygen consumption of the animal organism. (auth)

45824 INFLUENCE OF AET ON CERTAIN IMMUNOLOGIC PROCESSES IN RABBITS IRRADIATED BY RADIOACTIVE COBALT. Gidaly, M.; Gorgan, V.; Bilcea, M.; Uray, Z. (Inst. of Medicine, Cluj. Inst. of Oncology, Cluj). Agressologie; 12: No. 4, 269-73(Apr 1971). (In French).

A study was made of the protective effect of AET on the immunologic capacity of rabbits irradiated with 400 Rad of ^{60}Co γ and vaccinated with Salmonella typhimurium. The doses used have a strong immunosuppressive effect on the formation of agglutinins as well as on phagocytosis. AET has a pronounced radioprotective effect on phagocytosis but an undetectable effect on the formation of agglutinins. (tr-auth)

45825 EFFECTS OF X-IRRADIATION ON OVARIAN FUNCTION IN THE PREGNANT HAMSTER. Greenwald, Gilbert S. (Univ. of Kansas, Kansas City). Endocrinology; 91: No. 1, 75-86(Jul 1972).

Whether antral follicles are essential for luteal progesterone secretion in the hamster was assessed by eradicating follicles in an exteriorized ovary with 3000 rads on day one of pregnancy. Various parameters were compared between the irradiated (I) ovary and non-irradiated (N) ovary at different stages of gestation. When both ovaries were present, the N ovary showed an excessive increase in weight because of compensatory follicular development and the growth of corpora lutea (CL) at their normal rate. In contrast, the I ovary was reduced in size because of the stunted growth of the CL and the absence of antral and large multilayered follicles. Despite their different size in the second half of pregnancy, the CL and the I and N ovaries had the same content of progesterone, suggesting that under these circumstances, size per se of the CL did not reflect their functional capacity to produce the steroid. When the N ovary was removed at day 10 of pregnancy, the I CL commenced to grow and almost doubled their weight by day 16. The increased weight of the I CL occurred regardless of whether the semispayed hamsters were injected with estrone or the oil vehicle and was reflected in a significantly higher luteal content of progesterone than either the N or I ovaries when they were both in situ at day 16 of pregnancy. In hamsters, bilaterally ovariectomized at day 4 of pregnancy, it was necessary to inject estrogen as well as progesterone to maintain the optimal weight of embryonic swellings at day 8. In a group of irradiated hamsters, removal of the N ovary at day 4 resulted in reduced weight of embryonic swellings at day 8, comparable to the effects of injecting progesterone alone in the bilaterally ovariectomized animals. Thus, the I ovary (lacking antral follicles) secreted progesterone but none or insufficient estrogen to produce optimal decidualization. When the semispayed hamsters were given a single injection of estrogen, the embryonic swellings were restored to normal size. In animals bilaterally ovariectomized at day 10 of pregnancy, between 0.5 and 1 μg of estrone plus 1 mg progesterone was required on a daily basis to maintain pregnancy in all animals. When the N ovary was removed from irradiated animals on day 10 of pregnancy, pregnancy was terminated unless estrone was injected or fetuses were exteriorized. When the pregnant cornu was removed along with the N ovary, estrone was ineffective in maintaining the CL in the I ovary. This indicates that the effect of estrogen was not mediated directly on the CL. Collectively, these experiments demonstrate that antral follicles are the major (if not the only) source of estrogen in the pregnant hamster but that, in their absence, progesterone is still secreted by the CL. The essentiality of estrogen for the maintenance of pregnancy in the hamster is at the uterine level for interactions with progesterone. (auth)

45826 EFFECTS OF PARTIAL BODY IRRADIATION OF MICE ON THE QUANTITY OF 5-HYDROXYINDOL ACETIC ACID IN THE URINE, THE QUANTITY OF WATER CONSUMED, AND THE VOLUME OF URINE EXCRETED. Nakamura, W.; Nishimoto, Y. (National Inst. of Radiological Sciences, Chiba, Japan). Compt. Rend. Soc. Biol.; 165: No. 6, 1497-1501(1971). (In French).

Total, partial, or simulated irradiation produces variations in the following three biological criteria in mice: the quantity of 5-hydroxindol acetic acid in the urine, the quantity of water consumed, and the volume of urine excreted. A 600R irradiation of the head accentuates these variations. A total body irradiation significantly reduces the curves in relation to these criteria. Protection of the head ensures a return to the initial values. (France)

45827 EFFECT OF RADIATION ON THE REGENERATION OF MINCED AUTO-TRANSPLANT MUSCULAR TISSUES OF THREE-WEEK-OLD RATS. Bulyakova, N. V. Dokl. Akad. Nauk SSSR; 202: No. 3, 729-31(21 Jan 1972). (In Russian).

The process of muscular tissue regeneration following trauma (crushing) immediately and one to four months after local irradiation at 2,000 R was investigated to ascertain if the capacity of the irradiated muscle was restored to a myoblastic mode of regeneration. Four sets of experiments were conducted using different irradiation schedules. It was shown that local irradiation of the muscles of three-week old rats with 2,000 R suppressed the process of post-traumatic regeneration as demonstrated by the formation of granular tissue, myoblasts, and myosymplasts. These observations agreed with those of other workers on fully-grown rats. (K.S.W.)

45828 CHANGES IN THE LOCALIZATION OF ACETYLCHOLINESTERASE IN NEUROMUSCULAR JUNCTION AFTER ^{60}Co IRRADIATION. Faes, M. H.; Aubert, C.; Rosselle, N.; van der Schueren, G. (CEN, Mol, Belg.). Arch. Int. Physiol. Biochim.; 79: 269-77(1971). (In French).

The posterior appendages of 30 frogs (Rana esculenta) were exposed to 10, 20, 40, and 100 kR of ^{60}Co gamma radiation and the animals were killed at intervals up to 29 days after irradiation. The sartorius muscle was removed from both legs of each frog and prepared for histochemical study. Methods for identifying and localizing acetylcholinesterase are described and macro- and microscopic changes in the muscle and neuromuscular junction are discussed. It was found that radiation modified the localization and the microscopic structure of the supporting elements of the acetylcholinesterase. The junction did not appear to be more radiosensitive than the nerve or muscle. Alterations in the motor plate were accompanied by degeneration of muscle fibers. (H.L.W.)

45829 CHANGE OF CONTENT OF SULFHYDRYL GROUPS IN RAT HEART AND LIVER MITOCHONDRIA AND SUPERNATANT AFTER HIGH ENERGY IRRADIATION. Pegel, V. A.; Dokshina, G. A.; Dement'eva, T. A. (Scientific-Research Inst.

of Biology and Biophysics, Tomsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, No. 5, Ser. Biol. Nauk; No. 1, 108-13(Apr 1971). (In Russian).

The contents of thiol groups (total, protein, non-protein) were analyzed at 10, 30 min, 1, 2, 4, 6, 24, 48, and 72 hrs after irradiation (betatron 25 MeV) at a dose of 1000 rad in rat liver and heart mitochondria. A decrease in SH-group content in rat liver and heart mitochondria caused by irradiation was determined to proceed mainly on account of protein thiols. The non-protein sulphhydryl groups changed insignificantly. Decrease in titre of thiol groups in mitochondria was accompanied by its increase in supernatant. The latter indicates textural disturbance of subcellular fractions in the course of irradiation. (auth)

45830 REGENERATION OF LYMPHOID BONE MARROW IN THE THYMECTOMIZED ADULT MOUSE SUBJECTED TO A SUBLETHAL DOSE OF X RAYS. Schmitz, A.; Haot, J. (Univ., Liege). Compt. Rend. Soc. Biol.; 165: No. 6, 1467-9(1971). (In French).

Young mice were subjected to a 400 R x ray dose one month after they had been thymectomized. The absence of the thymus did not prevent the appearance of a large quantity of lymphoid cells in the bone marrow. The importance of this sudden production of medulla lymphoid cells in thymectomized animals suggests the possible regulatory function of the thymus in the regeneration of the bone marrow lymphoid cells after sublethal irradiation. (France)

45831 EFFECTS OF THYROIDIAN HORMONES AND γ IRRADIATION ON THE ADENYLCYCLASE OF THE PLASMA MEMBRANES OF THE RAT LIVER. Marc, J.-C.; Junien, J.-L.; Rocquet, G.; Michel, R. (Centre de Recherches du Service de Sante des Armees, Clamart, France. Univ., Paris). Compt. Rend. Soc. Biol.; 165: No. 6, 1257-62(1971). (In French).

The adenylcyclase system of the liver plasma membranes is activated by several substances, and in particular by thyroid hormones. It is known that γ radiation modifies the functions of certain biological molecules. This fact was utilized in locating the adenylcyclase activation sites in the presence of NaF and glucagon, and in studying the behavior of 5′ nucleotidase. After the first hour of irradiation (25740 rads) the effect of the glucagon is considerably reduced and after two hours of irradiation (51480) rads the effect was totally inhibited; NaF, however, retains a stimulating effect after two hours. The nucleotidase is not significantly modified. (France)

45832 PHENOL RED UPTAKE BY IRRADIATED AND NON-IRRADIATED CHICK MESONEPHROS IN VITRO. de Ridder, Leo I.; Mareel, Marc M. (State Univ., Ghent). Lab. Invest.; 26: No. 5, 600-3(1972).

Ionizing irradiation has a stimulating effect on phenol red uptake in the proximal tubules of the 9-day chick mesonephros. The uptake and the radiobiologic effect on it are temperature-dependent. The latent period between irradiation and effect is only 30 minutes as shown by liquid scintillation counting. The selective uptake in the proximal tubules can be demonstrated by the autoradiographic technique for water-diffusible compounds. However, by this morphologic method, no quantitative difference can be seen between irradiated and control cultures. (auth)

45833 EFFECTS OF X IRRADIATION UPON THE RESPONSE OF MONONUCLEAR PHAGOCYTES TO AN INDUCED STERILE INTRAPERITONEAL INFLAMMATION. Harper, John R.; Wolf, Norman S. (Univ. of Washington, Seattle). Res. J. Reticuloendothel. Soc.; 11: No. 4, 368-82(1972).

The radiosensitivities of the populations of mononuclear phagocytic cells (and their precursors) which respond to intraperitoneal stimulation with thioglycollate broth were examined in the mouse. X irradiation (500 to 1000 R) given 24 hours previous to the stimulation reduced the number of such cells collected from the peritoneal cavity four days poststimulation to the level of unstimulated animals. Similar irradiation given 24 hours poststimulation had no or little effect under otherwise similar circumstances. With time represented on the abscissa and cell numbers collected on the ordinate, progressively shortened poststimulus irradiation times resulted in a falling asymptotic curve through the coincidence point of stimulation and irradiation times. Intraperitoneal mitosis did not account for cellular accrual. Two populations of cells, based on radiosensitivity and the mitotic event, are suggested on the basis of the relationships of the numbers of cells collected at varying times before and after irradiation and known data for post-irradiation mitosis among cell populations. (auth)

45834 SUPPRESSION AND RECOVERY OF COLONY FORMING UNITS IN THE RAT FOLLOWING SUB-LETHAL X IRRADIATION. Okunewick, James P.; Phillips, Eleanore L. (Allegheny General Hospital, Pittsburgh). Contract AT(11-1)-3097. Exp. Hematol.; 22: No. 1, 26-7(Mar 1972).

Rats were exposed to a single whole-body 200 R dose of x rays and were killed at selected intervals following irradiation. Marrow was removed from the excised femurs and cell suspensions were prepared. The cells were then injected into irradiated mice, the spleens excised, fixed, and the colonies counted. Graphs are presented to show results. The data indicated that recovery of the total nucleated marrow proceeds at a faster rate than recovery of transplantable colony-forming units. The colonies developed normally after transplantation regardless of when the donor cells were taken from rats. The prolonged repression of the CFU compartment suggested that factors other than residual effects of radiation act on the bone marrow CFUs after low level x radiation exposure. (H.L.W.)

45835 VASCULAR ALTERATION IN THE IRRADIATED BONE MARROW OF THE RABBIT MANDIBLE. A MICROANGIOGRAPHIC STUDY. Mori, Ryoichi (Kanazawa Univ., Japan). Kanazawa Irigaku Sosho; 89: 51-69(Jun 1971). (In Japanese).

The mandible bones of mature rabbits were exposed to repeated ^{60}Co γ ray doses. The total irradiated doses of five groups were 3,000 R, 5,000 R, 7,000 R, 9,000 R and 12,000 R, respectively. The morphological changes of irradiated minute blood vessels were observed microangiographically, and the pathological changes of blood vessels and marrow tissues were investigated histologically. Dilations and constrictions of minute arterial vessels were observed under 5,000 R irradiation. The capillaries were constricted and were represented by only fine threads at irradiation over 5,000 R. The venous sinus showed a tendency to dilatation at radiation doses over 7,000 R. Dilatations, constrictions, and the presence of thrombi in the veins were investigated under conditions of over 7,000 R irradiation. Edema of the mandibular marrow occurred at doses over 7,000 R. Reticular cells and fibers increased in proportion to the dose. A comparison of radiation effects on blood vessels and bone marrow showed that changes appeared in blood vessels at doses under 5,000 R, but that changes in bone marrow appeared only at doses over 7,000 R. (H.L.W.)

45836 EFFECT OF IONIZING RADIATION ON ENZYME ACTIVITY IN THE NEUROGLIA OF THE DEVELOPING RABBIT BRAIN. Wender, M.; Kozik, M.; Owsiankowski, M. (Medical Academy, Poznan, Poland). Folia Histochem. Cytochem. (Krakow); 9: 299-304(1971).

The activity of acid and alkaline phosphatase, thiamine pyrophosphatase, adenosine triphosphatase, non-specific esterase, acetylcholinesterase, and butyrylthiocholinesterase was examined in the developing neuroglia of the rabbit brain exposed to a single dose of 150 R of x-rays on the 18th day of fetal life. The investigation led to the following conclusions: The results of histoenzymatic examinations of the activities of acid and alkaline phosphatases, TPPase, and ATPase in the irradiated animals do not differ perceptibly from those obtained for normal development. The activity of butyrylthiocholinesterase in the myelinated fibres of the animals irradiated in fetal life does not vary from that observed for physiological conditions. On the other hand, no increase in the activity of this enzyme can be recorded in the process of maturation of the interfascicular oligodendroglia. This divergence becomes very distinct as soon as the myelinization process is concluded. The activity of butyrylthiocholinesterase in the interfascicular oligodendroglia does not play any substantial role in the metabolism of the myelin components. (NSA of Poland)

45837 ROLE OF TRANSPLANTED SLOWLY PROLIFERATING BONE MARROW CELLS FOR REGENERATION OF LETHALLY X-IRRADIATED RAT BONE MARROW. Haas, R. J.; Meyer-Hamme, K.; Fliedner, T. M.; (and others) (Univ. of Ulm, Ger.). Scand. J. Haematol.; 9: No. 2, 121-9(Apr 1972).

Inbred Lewis rats were labeled with ^{3}H-thymidine (^{3}H-TdR) in utero and for 6 weeks after birth to obtain 100% labeling of all the cells in the animals. Six weeks after the last ^{3}H-TdR injection only cytokinetically resting cells were still labeled. These cells comprised of two types of reticular cells, endothelial cells and a small fraction of bone marrow lymphocytes. At this time the animals were treated with 4×500 mg/kg body weight hydroxyurea at 6 hrs intervals. A profound marrow hypoplasia was obvious 6 hrs after the last HU injection. All proliferating precursor cells of the bone marrow were destroyed, whereas the cytokinetically resting cells were not changed in their absolute number. Successful transplantation of the marrow treated with HU to 1200 R x-irradiated recipients provided evidence for the presence of stem cells in the bone marrow of the donors and indicated that in rats, bone marrow regeneration can be achieved in the absence of cells morphologically defined as hemocytoblasts. (auth)

45838 EFFECTS OF IONIZING RADIATION ON THE STRUCTURE AND METABOLISM OF MITOCHONDRIA IN RAT LIVER CELLS. Zyss, Ryszard; Michalska-Kaszczynska, Maria

(Inst. of Postgraduate Medical Education, Warsaw). Acta Med. Pol.; 13: No. 2, 161-75(1972).

Using ultrastructural, cytochemical, and biochemical methods the character and intensity of morphological and structural changes in liver cell mitochondria of rats receiving a whole-body radiation dose of 1000 R were studied. It was found that swelling of varying intensity is the main form of morphological mitochondrial damage. With marked swelling, the matrix of the mitochondria and their membranes are damaged with disappearance of cristae and with focal disruption of membranes. The damaged mitochondria undergo sequestration—they are enveloped with membranes of the endoplasmic reticulum with development of the so-called cytosegrosomes. Ultrastructural changes of mitochondria were associated with changes in their enzymatic activity, with a fall in the activity of succinic dehydrogenase and with a rise in the activity of ATP-ase. This suggests that structural damage to the mitochondria varies in its influence on the direction of changes in their enzymatic activity with the activity of ATP-ase being more dependent on the structural damage of mitochondria than the activity of succinic dehydrogenase. Explaining the mechanism of development of radiation-induced disturbances in the structure and functions of mitochondria, the authors consider that, most probably, these disturbances are due to changes in the physico-chemical characteristics of lipoprotein membranes caused by radiation. Damage to the lipoprotein membranes of mitochondria seems to be due mainly to disturbances in phospholipid metabolism. (auth)

45839 LYSOSOMAL SYSTEM OF LIVER CELLS IN RATS FOLLOWING A RADIATION DOSE OF 1000 r TO THE WHOLE BODY. Zyss, Ryszard; Michalska-Kaszczynska, Maria (Inst. of Postgraduate Medical Education, Warsaw). Acta Med. Pol.; 13: No. 2, 177-92(1972).

Following an x-ray dose of 1000 R to the whole body of rats, a progression of morphological changes including mainly an increase in the number of lysosomal structures—cytosomes, cytosegresomes, multivesicular bodies, and microbodies was observed. The increase in the number of these structures is a measure of the intensity of radiation-induced damage to the cells. Using histochemical, biochemical, and cytochemical methods, the level of acid phosphatase in the lysosomes was investigated. A progressing increase in the activity of this enzyme was observed. In biochemical investigations, this increase was reflected in the increasing total activity of this enzyme in the lysosomal fraction. A similar increase in the activity of this enzyme observed at the same time in the supernatant is explained by increased permeability of lysosomal membranes. A considerable role in the development of radiation-induced damage to the cellular structures is attributed to the observed changes in the metabolism of phospholipids. (auth)

45840 EFFECTS OF RADIOPROTECTIVE AGENTS ON HEMATOLOGICAL INDEXES AND IRON METABOLISM IN MICE THAT WERE EXPOSED TO MIXED RADIATIONS FROM A REACTOR. Santha, Andras; Sztanyik, Laszlo; Mandi, Erika; (and others). Honvedorvos; 24: No. 1, 46-60(1972). (In Hungarian).

To assess the radiation injury caused by mixed γ-neutron radiations from an atomic reactor in mice, peripheral blood picture and reticulocyte count were not sensitive as indicators. Incorporation of ^{59}Fe in erythrocytes, however, proved to be a sensitive test. Iron incorporation closely reflected both radiation dose and neutron-γ ratio. AET protected against γ as well as neutron radiation; 5-MOT protected only against γ radiation. It was concluded that preventive medications for mixed radiation injury should not contain Mexamine (5-MOT). (H.B.G.)

45841 BODY WEIGHT DECREASES IN SOME PROTON EXPOSED PRIMATES. Kirk, John H. (School of Aerospace Medicine, Brooks AFB, Tex.). Space Life Sci.; 3: No. 3, 271-7(Jun 1972).

Immature Macaca mulatta were exposed to varying doses of whole body irradiations utilizing 2 MeV x-rays; 55, 138, and 400 MeV protons; and 2.3 GeV protons. Over 200 primates remain in a life-long study group for irradiation effects. Mean body weight decreases as a function of age, sex, dose, and irradiation type were found in the 55 MeV proton exposed group but not in the other groups. The cause of the decreased weights is unknown at present, as is the reason for the lack of this effect in the more penetrating irradiations. (auth)

45842 DEOXYRIBONUCLEIC ACID METABOLISM IN THE SMALL INTESTINE IN VIVO AND IN VITRO. A STUDY OF THE NORMAL AND 180-MeV PROTON OR ^{60}Co GAMMA IRRADIATED MOUSE. Johanson, Karl J. Abstracts of Uppsala Dissertations from the Faculty of Science, No. 204. Uppsala; Univ. of Uppsala (1972). 26p.

Thesis.

Iodine-125-labeled IUdR was found to be a very specific precursor for intestinal and splenic DNA with little labeling by other molecules. No significant differences in the kinetics of the catabolism of ^{125}IUdR were seen in irradiated mice, as compared with control mice. In estimating the radioinduced decrease in ^{125}IUdR incorporation into DNA, similar results were obtained by biochemical and autoradiographic methods and also by measurements of the total ^{125}I retention in the whole small intestine. The relative biological effectiveness, based on the incorporation of ^{125}IUdR into intestinal DNA, was 1.2 ± 0.3, as found by comparison of 180-MeV protons with ^{60}Co gamma radiation, and the ^{125}I retention after ^{125}IUdR injection was similar. Changes in the thymidine pool due to flooding by thymidine from dead cells seem to be of minor importance, judging from comparison of fluorouracil-treated control and irradiated mice. Segments of the small intestine were viable after 180 minutes culturing on a Millipore filter in the interface between T8 medium and an atmosphere of 95% oxygen and 5% carbon dioxide. This technique should be a valuable tool for radiobiological studies of the small intestine. (auth)

45843 VARIATIONS IN THE BONE MARROW LYMPHOID POPULATION IN THE SUBLETHALLY IRRADIATED GERM FREE MOUSE. Haot, J.; Gustafsson, B.; Boniver, J.; Revesz, L. (Karolinska Inst., Stockholm, Univ., Liege). Compt. Rend. Soc. Biol.; 165: No. 6, 1470-2(1971). (In French).

Apart from a slight delay in the thymic regeneration, the hematopoietic regeneration occurring in mice, which have received a sublethal dose of irradiation, does not appear to be very different from that of nonirradiated animals of the same strain, age, and sex. An accumulation of lymphoid cells, characteristic of the regeneration after irradiation, is found in the bone marrow of the germ-free mice. These lymphoid cells present the morphological characteristics of the x cells at the 12th day. (France)

45844 PROTECTION AGAINST GASTROINTESTINAL EFFECTS OF WHOLE-BODY X-IRRADIATION BY A BILE ACID SEQUESTRANT IN RATS. Parkinson, T. M.; Drake, N. A. (Upjohn Co., Kalamazoo, Mich.). Experientia; 28: No. 5, 553-4(15 May 1972).

Previous studies showed that cannulation of the bile duct reduced the loss of sodium and prolonged survival of rats exposed to ionizing radiation. These observations suggested that oral administration of a bile acid sequestrant, DEAE Sephadex, might increase survival times of x-irradiated rats. Therefore, rats were exposed to 1250 to 2100 R of x radiation and were allowed free access to food and water following irradiation. DEAE Sephadex was administered by stomach tube; controls were given distilled water. All rats died within nine days following irradiation. However, the survival time of rats treated with DEAE Sephadex was increased by 1.2 days. It is pointed out that bile acid sequestrant therapy might provide a means of reducing the severity of secondary effects of ionizing radiation in the human gastrointestinal tract. (H.L.W.)

45845 SENSIBILISATION IN RADIOBIOLOGY AND RADIOTHERAPY. Pohlit, W. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Frankfurt am Main). Strahlentherapie; 143: No. 3, 348-52(Mar 1972). (In German).

A review is presented of various aspects of sensitization of living cells to ionizing radiation. The possibilities for radiosensitization of the different structures of the cell, tissues, and the entire organism are discussed. The role of DNA as a target molecule is emphasized and the reactions of DNA with radioinduced hydroxyl radicals with a high redox potential are discussed. Other topics reviewed are: effects of cell phase on sensitization; relation of sensitization to cell repair of radiation injuries; therapy with fast neutrons and mesons; effects of radioinduced radicals on nucleotides; radioinduced strand breaks in DNA; and immune reactions of living cells against radiation and chemicals. (H.L.W.)

45846 ACUTE DEATH OF MICE DURING MASSIVE GAMMA IRRADIATION. 3. Takeshita, Kenji (Hiroshima Univ.); Umayahara, Akira; Fujii, Kyoichi. Nippon Igaku Hoshasen Gakkai Zasshi; 31: No. 2, 133-42(May 1971).

An electrocardiographic observation was conducted to study the effect of massive irradiation of ^{60}Co gamma rays given to ICR female mice in a short period of time. The relation between exposure rate and the total exposure leading to death during irradiation was studied in the range of 10 R/min to 40 kR/min. The result indicated that the exposure rate was in proportion to the total exposure leading to death. The relation between the exposure rate and the time until death during irradiation represented almost a direct line in the log–log graph, although dose dependency was observed to some extent. Intraperitoneal injection of 2.5 mg phenobarbital was given 10 minutes before irradiation with 40 kR/min. The exposure rate leading to death was 2.6 times larger. An electrocardiographic observation was conducted continuously

from the beginning of irradiation until death was confirmed. The total exposure delivered was 18 kR which exceeded the 3.5 day effect in the relation to mean survival time and dose. However, the effect was equal to the delay of acute death during irradiation. The heart rate and electromyographic frequency in convulsions during irradiation were determined. The heart rate generally increased with irradiation; no significant change was observed with barbital injection. The electromyographic frequency indicated no definite pattern in convulsions during irradiation. Mean survival time of irradiated mice was determined and expressed as an exponential function of the given dose. (Japan)

45847 EFFECT OF VARIOUS CELL-FREE ORGAN EXTRACTS ON HEMATOPOIETIC STEM CELLS. Dons, R. F.; Fried, W.; Trobaugh, F. E. Jr.; Knospe, W. H. (Univ. of Illinois, Chicago, Rush Presbyterian St. Luke's Hospital, Chicago). Exp. Hematol.; 22: No. 1, 30-2(Mar 1972).

Tissue extracts were prepared by homogenizing mouse organs, centrifuging, and collecting the supernatant; each of the supernatants was then diluted with saline. Mice were injected with one ml of supernatant or one ml of normal saline and 2 hrs later the mice received 200 R whole-body x radiation. Four days later the mice were killed and cells were flushed from the femoral marrow, and the number of nucleated cells per ml of suspension was determined. One half ml of each suspension was then injected into each of 20 mice that had received 750 R x radiation. Nine days later the number of spleen colonies was counted. A significantly greater number of CFU was observed in mice treated with spleen, kidney, liver, lung, or stomach extracts than in saline-treated mice. (H.L.W.)

45848 GLUCOSE-6-PHOSPHATE PHOSPHOHYDROLASE ACTIVITY IN ERYTHROCYTES AFTER X-IRRADIATION. Moisiu, M.; Chisleag, C.; Ababei, L. (Inst. of Medicine and Pharmacy, Iasi). Stud. Biophys.; 28: No. 3, 199-206(1971).

After a single whole-body x irradiation with 600 R, glucose-6-phosphate phosphohydrolase activity fell in rabbit erythrocytes from 4.20 to 3.12 μmole-ml cells$^{-1} \cdot h^{-1}$ and in rat erythrocytes from 3.56 to 2.40 μmole $\cdot$ ml cells$^{-1} \cdot h^{-1}$. Cysteine and reduced glutathione (GSH) had no effect on G-6-Pase activity in normal erythrocytes, but restored enzymatic activity in the irradiated erythrocytes. Parachlormercury-benzoate (PCMB) inhibits G-6-Pase activity more strongly in the erythrocytes of normal than of irradiated animals. Inhibition was reversible with cysteine and GSH. (auth)

45849 PROTEIN SYNTHESIS IN NORMAL, X-IRRADIATED, AND FRIEND VIRUS INFECTED MOUSE SPLEEN NUCLEI. Munson, B. R.; Fiel, R. J. (Park Memorial Inst., Springville, N. Y.). Res. Commun. Chem. Pathol. Pharmacol.; 1: No. 4, 517-25(Jul 1970).

Nuclei were isolated and purified from normal, x-irradiated, and Friend virus (FV) infected mouse spleen and analyzed for their relative incorporation of ^{3}H-labeled amino acids. The data show that incorporation into FV infected nuclei was less than into normal spleen nuclei. Conversely, incorporation into spleen nuclei from x-irradiated mice was found to be stimulated although the level returned to normal in regenerated spleen. (auth)

45850 NEUROPATHOLOGICAL EVALUATION OF MONKEYS EXPOSED TO BODY-ALONE X-RADIATION. Haymaker, Webb (Ames Research Center, Moffett Field, Calif.); Sturrock, David; Kirk, John H.; Casey, Harold W.; Call, Nancy A. Space Life Sci.; 3: No. 3, 210-25(Jun 1972).

Twelve monkeys (Macaca mulatta) were x-irradiated and six controls received sham treatment. The radiation dose was 600 rad to the trunk and 6 rad to the head. Hematological studies before and after exposure included total leukocyte counts, platelet counts, hemoglobin concentrations, microhematocrits, and total red cell counts. At autopsy, specimens were removed from the cerebrum, cerebellum, and brain stem, placed in fixatives, and prepared for histological study. Photographs and tables describing abnormalities in the central nervous system are presented. The most striking change consisted of hypertrophy and multiplication of microgliocytes in the molecular layer of the cerebellum. (H.L.W.)

45851 OCULAR SQUAMOUS CELL CARCINOMA (CANCER EYE) IN HEREFORD CATTLE: RADIATION REPAIR PROCESSES AND A COMPARISON OF CULTURED CELLS WITH XERODERMA PIGMENTOSUM IN MAN. Cleaver, J. E. (Univ. of California, San Francisco); Kainer, R. A.; Zelle, M. R. Amer. J. Vet. Res.; 33: No. 6, 1131-6(Jun 1972).

Epidermal cells and fibroblasts were cultured from skin biopsy samples taken from the lower eyelids of Hereford and black Aberdeen Angus cows to determine if the predisposition of Herefords to ocular squamous cell carcinoma (cancer eye) is due to an enzymatic defect in the repair synthesis of deoxyribonucleic acid (DNA) damaged by ultraviolet (uv) light. This reparative defect is present in xeroderma pigmentosum (xp), a human disease in which ocular squamous cell carcinoma occurs. Differences were not observed between the Hereford and Aberdeen Angus cows in sensitivity of their cells to uv light or in the level of DNA repair synthesis. Cancer eye in Hereford cattle appears to be distinct from xp in man and not attributable to a defect in DNA repair. (auth)

45852 WHOLE-BODY GAMMA IRRADIATION OF NEWBORN PIGS: HEMATOLOGIC CHANGES. Case, Marvin T.; Simon, Joseph (Coll. of Veterinary Medicine, Urbana, Ill.). Amer. J. Vet. Res.; 33: No. 6, 1217-22(Jun 1972).

Newborn Yorkshire pigs were exposed to 150, 250, 300, 350, 375, 400, and 450 R of ^{60}Co γ radiation. Lymphopenia developed in the irradiated pigs usually within 24 hours after irradiation. Bone marrow damage caused neutropenia and anemia to develop 10 to 14 days after irradiation. Lymphopenia and neutropenia were responsible for the leukopenia in the irradiated pigs. Pigs exposed to a lethal dose of radiation had a gradual decrease of erythrocytes and leukocytes until death occurred. (auth)

45853 WHOLE-BODY GAMMA IRRADIATION OF NEWBORN PIGS: PATHOLOGIC CHANGES. Case, Marvin T.; Simon, Joseph (Coll. of Veterinary Medicine, Urbana, Ill.). Amer. J. Vet. Res.; 33: No. 6, 1223-30(Jun 1972).

Newborn Yorkshire pigs were exposed to 150, 250, 300, 350, 375, 400, and 450 R of ^{60}Co γ radiation. Hemorrhage was the principal lesion in the pigs which died 10 to 29 days after exposure to lethal doses of radiation (350, 375, 400, and 450 R). Hemorrhages were always found in the heart, lymph nodes, and skin and were often present in skeletal muscle, intestine, kidney, and brain. Hemopericardium, hemoperitoneum, or hemorrhage into the intestinal lumen were often severe enough to cause death. Destruction of hematopoietic cells occurred in lymph nodes, Peyer's patches, spleen, and bone marrow. Peyer's patches and bone marrow returned to histologic normalcy more rapidly than did lymph nodes and spleen. Radiation pneumonitis developed in the irradiated pigs and was most severe at 35 days after irradiation. (auth)

45854 EFFECTS OF RADIATION AND HYPOXIA ON THE METABOLIC FATE OF ERYTHROPOIETIN. Carmena, A. O. (Tufts Univ., Boston). Acta Radiol., Ther., Phys., Biol.; 10: No. 5, 497-503(Oct 1971).

Sprague–Dawley rats were kept at 19,000 feet for various periods. The animals that received 200 R whole-body irradiation had a significantly increased plasma erythropoietin. It is concluded that the levels of erythropoietin are in inverse relationship to the cellularity of the erythroid precursors. (auth)

45855 CULTURE OF MURINE LEUKEMIC CELLS INDUCED BY X-IRRADIATION. Iwai, Yoshiaki; Takamori, Yasuhiko; Okumoto, Masaaki. Annu. Rep. Radiat. Center Osaka Prefect.; 12: 113-19(1971).

Ascites leukemic cells derived from splenic reticular sarcoma induced by x-irradiation in RF mice were successfully cultivated in vitro. At early passages in vitro, the culture cells adhered less firmly to the glass and tended to float into the culture fluid. The culture cells altered epithelial like cells with increasing time of cultivation. The change in cell shape was accompanied by the changes in enzymatic activities of the cells, and by loss of retransplantability in the isologous mice. (auth)

45856 COMPARATIVE CHARACTERISTICS OF NUCLEOTIDE BLOCKS OF DNA IN RADIATION INJURY AND LEUKOSIS. Kritskii, G. A.; Batishchev, A. I.; Aleksandrov, S. V.; Fedorov, N. A.; Abramov, R. E. (Inst. of Biochemistry, Moscow). Dokl. Akad. Nauk SSSR; 203: No. 1, 233-6(1 Mar 1972). (In Russian).

The distribution of nucleotide blocks of DNA was studied under conditions of radiation damage and leukosis. White rats were given 500 R of x radiation, and after decapitation the bone marrow of the limbs was frozen, thawed, and examined. The change in the ratio of the nucleotide blocks in DNA of the hematopoietic tissues of animals during radiation injury and during leukosis possessed similar character. (K.S.W.)

45857 VASCULARIZATION OF MUSCULAR AUTOTRANSPLANTS DEVELOPED IN AN IRRADIATED SITE. Umnova, M. M. (Inst. of Biological Physics, Pushchino-na-Oka, USSR). Dokl. Akad. Nauk SSSR; 203: No. 1, 248-50(1 Mar 1972). (In Russian).

The effect of irradiation on the development of the blood supply in an autotransplant of the gastrocnemial muscle of the rat was studied. Experiments were conducted with 70 white rats weighing 120 to 130 g and unidentified as to strain. The right rear leg was

given a dose of 2,500 R (type of radiation not specified). The gastrocnemial muscle was removed, and in its place the contralateral unirradiated muscle was transplanted. The proximal part of the muscle and Achilles tendon were sewn to fragments of tendon of the removed muscle. The tibial nerve was sewn underneath to the mid-part of the transplant. Observations of the animals were made over a period of two months, and revealed that the rate of vascularization and reorganization of the unirradiated transplants varied in accordance with the radiation dose received by the transplant site. As a result of the radiation damage, the regeneration capacity of the blood vessels in the transplants was suppressed to a significant extent. In spite of this, anastomosis occurred and assured vascularization in the transplant. (K.S.W.)

45858 REMOTE EFFECTS, IN TIME AND PLACE, OF X IRRADIATION OF THE VISUAL CORTEX IN THE MONKEY. Caveness, William; Kato, Motohiro; Hess, Kenneth H.; Carsten, Arland L. Trans. Amer. Neurol. Ass.; 96: 217(1971).

Six to eight months after subjecting the right occipital lobe to a single exposure of 3,500 rads by 250 KV x-rays, eight young adult Macaca mulatta showed alterations in the photic evoked response from the visual cortex. Two showed unilateral depression in amplitude over the irradiated area, and six showed bilateral depression in amplitude, that is, over the homologous non-irradiated as well as the irradiated area. Of the latter, four showed behavioral loss in vision, and funduscopic evidence of optic atrophy. Upon sacrifice, in addition to the expected degenerative and proliferative changes in the right occipital lobe, there was diffuse brain swelling, severe in one instance, with intra- and extracellular fluid accumulation. But more intriguing was a partial loss in fibers in the optic nerves with the loss being predominantly on the temporal side in the right eye and nasal side in the left eye. (auth)

45859 RADIOMODIFYING CHEMICALS FOR BACTERIA AND MICE. Mulligan, David Dwight. Gainesville, Fla.; Univ. of Florida (1971). 200p. University Microfilms Order No. 72-16,637.

Thesis.

Chelating compounds were tested for their ability to modify the x-ray sensitivity of suspensions of stationary phase Escherichia coli B/r bacteria, and of female mice, age 12 to 15 weeks, strain $BC3F_1/C$. The bulk of the toxicity and radiomodification experiments were conducted using the following para-substituted, phenyl-containing chelating structures: thiocarboxylic acids, sulfinyl- and sulfonylcarboxylic acids, mercaptoalkylamines, and ammonium dithiocarbamates. In general for bacteria, the toxicity decreased and the radioprotection increased for a corresponding increase in electron-donating character of the para-substituents. Some electron-withdrawing groups caused radiosensitization for bacteria. On a per chemical dose basis, protection of mice usually increased as the electron-donating power of the substituents increased. Electron-withdrawing groups generally decreased protection for mice, but did not cause radiosensitization. The compounds that were the most protective were generally the least toxic to the bacteria and the mice and could therefore be employed in large amounts, affording greater protection against x rays. The powerful chelating agent, 8-mercaptoquinoline, was protective to mice but was also quite toxic. When it was used with an effective radioprotectant, AET, the combined effect was protection at considerably higher x ray doses than with either compound alone. A group of thiolsulfonates were found whose low toxicity to mice and high toxicity to bacteria recommends that they be further investigated as possible antimicrobial agents for mammals. Several compounds ($BrC_6H_4SCH_2COOH$, $ClC_6H_4NHCSSNH_4$, $(NO_2C_6H_4)_2S$, and $(CH_3)_2NCSS$-Na) were found to be particularly radiosensitizing to bacteria but at least moderately radio-protective to mice, indicating a possible use in selectively potentiating the toxicity of radiotherapy for tumors while protecting the whole animal from radiation. (Diss. Abstr. Int., B)

45860 X-IRRADIATION OF THE SKIN OF THE BEAGLE. Park, Richard Dee. Davis, Calif.; Univ. of California (1971). 173p. University Microfilms Order No. 72-17,922.

Thesis.

Single-dose and fractionated-dose x-irradiation studies were performed on the skin of Beagle dogs. In the single-dose study, five 48 cm^2 areas of skin were irradiated over the neck and back of the dogs. The doses used were 610, 1220, 1830, 2440, and 3660 rads. In the fractionated-dose study, 17 schedules were used varying fractionation dose, fractionation interval, and protraction time. Total dose was constant at 5800 rads. All animals were sacrificed approximately 120 days after the initial radiation treatment. Irradiation was done with a 200 kVp, 15 ma beam having a HVL of 5 mm Al, a FSD of 50 cm and delivering 195 R/minute. Gross observation, histopathology, autoradiography, and angiography were used to evaluate the radiation induced changes in skin. Thermoluminescent dosimetry with LiF crystals was used to confirm that the radiation absorbed dose to the skin over the irradiated field was homogeneous; the backscatter factor was lower than reported; and skin over the thorax received less absorbed radiation than other areas with similar exposures because of a lower backscatter from the air filled lungs. Acute radiodermatitis from single-dose irradiation was proportional to the dose level. Chronic radiodermatitis was dose and time dependent. The following acute dose effects were observed; 610 rads produced erythema, 1220 rads produced dry desquamation, 1830 rads produced a moist desquamation; and 2440 or 3660 rads produced ulcers. Large, slow healing ulcers were seen with 3660 rads. Chronic radiodermatitis dose effects, observed no sooner than 50 days after irradiation, were; 610 rads produced slight or no changes, 1220 rads produced gray hair, 1830 rads produced patchy epilation, and 2440 and 3660 rads produced atrophic skin with some residual ulcers and tendencies for reulceration. Chronic histopathologic changes observed with 1220 rads and above consisted of dermal hyperplasia, increased dermal connective tissue, and infiltrating phagocytic mononuclear cells around dead skin structures. The hair follicles were the most radiosensitive skin structure followed by the sebaceous glands. The synthesis of DNA by epidermal cells was not directly affected by radiation as determined by the epidermal uptake of thymidine-^3H immediately after irradiation and subsequent autoradiographic studies. Some areas of skin that received 1830 rads or more were hypovascular. Chronic vessel changes consisted of narrowing of the vascular lumen as the vessels entered the irradiated skin, proliferation of small vessels around the periphery of the irradiated skin and some large hypertensive peripheral vessels. It was proposed that the vascular changes predisposed the skin to reulcerate. To evaluate the final chronic effects of 2440 and 3660 rads an observation time of 6 months to 1 yr should be allowed. The epidermis was sloughed from all areas in the fractionated-dose study. The total dose of 5800 rads was concluded to be too high. A trend toward skin sparring, both acute and chronic, was noticed in areas irradiated with relatively intermediate fractionated levels of 600 and 800 R and a protraction time of 20 days. More studies are needed to establish safe radiation dose fractionation schedules in the dog. (Diss. Abstr. Int., B)

45861 DOSE TO THE EPITHELIUM OF THE UPPER RESPIRATORY TRACT FROM RADON AND ITS DAUGHTER PRODUCTS. Bykhovskii, A. V.; Khachirov, Dzh. G.; Shishkanov, N. G.; Dubrovin, S. A.; Klyuch, V. E. Health Phys.; 23: No. 1, 13-22(Jul 1972). (In Russian).

The study of the effects of ^{222}Rn and its daughter products on the organism is one of the most important problems both of radiation hygiene and radiobiology. Tests were carried out on animals for the more accurate definition of the irradiation dose to the epithelium of the upper respiratory tract and to study its dependence on the concentration of radon and its daughter products. The direct radiometry of the alpha-activity in different parts of the respiratory tract enabled calculation of the dose in the basal epithelium layer of the trachea and main bronchi. It was shown in the course of the study that the dose production is essentially due to the daughter products of ^{222}Rn which do not combine with aerosol particles of the air of the test chamber. (auth)

45862 EXPERIMENTAL STUDIES ON THE PERMEABILITY OF LINGUAL MUCOSA IN RADIATION GLOSSITIS. Takeda, Ryuichi (Kanazawa Univ., Japan). Kanazawa Irigaku Sosho; 88: 33-60(Apr 1971). (In Japanese).

Progress of the experimentally irradiated lingual mucosa of rabbits from onset of inflammation to healing was observed macro- and microscopically. In the group irradiated with a single dose of 1800 rads of β-ray, the radiation glossitis showed the following processes: incubation period within 24 hrs, incipient stage for 3 to 5 days, middle stage for 6 to 9 days, and the final stage after 10 days. In the group irradiated with a single dose of 2500 rads of β-ray, the incipient inflammation was manifested after 2 days followed by the middle stage for 6 to 12 days, and the final stage. The latter group showed more severe inflammatory process and the prolonged period of the inflammation. In two groups irradiated with a single dose of 2500 rads x rays and ^{60}Co γ rays, the inflammatory process appeared almost the same. A comparative study between the radiation glossitis and its related permeability with ^{24}Na was carried out. Three days after irradiation, the permeability was slightly reduced in all groups regardless of radiation sources or dosages. In the severe ulcerated glossitic stage during 7 to 10 days, the ^{24}Na uptake was the highest. In autoradiograms, a deeper permeability was observed in particular at the area of ulceration with less epidermis. The ^{24}Na uptake decreased day by day in the recovering stage. The permeability came back nearly to the level of preirradiation 31 days after the irradiation. (Japan)

45863 EXPERIMENTAL STUDIES ON THE PULMONARY RADIATION INJURY. Oikawa, Masaru (Iwate Medical Coll.,

Morioka, Japan). Nippon Igaku Hoshasen Gakkai Zasshi; 31: No. 4, 426-42(Jul 1971). (In Japanese).

When irradiated, lungs of rats showed histologic changes similar to those seen in man with radiation pneumonitis, while lungs of rabbits did not show histologic change. The alveolar sac stability ratio tended to decrease at the early stage of the pulmonary radiation injury in rats suggesting that the primary manifestation of the injury was in the pulmonary surfactant systems. The early histologic changes characteristic of the injury in rats were edema in the alveolar space and interstitum, fibrin deposition, bizarre cells, foamy cells and atelectasis. As for the intermediate changes, capillary thrombus, the Masson body, and onionskin appearance like allergic inflammations are seen. Those changes were also seen in the non-irradiated lung though less frequent. In the present study, there was no qualitative difference in the pulmonary damages between irradiated and non-irradiated areas. These results favor the allergic involvement in the pathogenesis of pulmonary radiation injury. (auth)

45864 STUDY ON THE RBE OF VARIOUS TYPES OF RADIATION. Takahashi, Akira (Hiroshima Univ.). Nippon Ganka Gakkai Zasshi; 75: No. 7, 1661-9(Jul 1971). (In Japanese).

One eye of normal young albino rabbits, 10 to 15 weeks old, was irradiated with one of the following types of radiation and follow-up observation was made for a period of more than 60 weeks. The types of radiation used were 180 kv x rays and gamma rays (^{60}Co energy source) administered in the six different doubling doses of 50, 100, 200, 400, 800, and 1600 rad, and 14.1 MeV fast neutrons and mixed neutrons and gamma rays were administered in the five different doubling doses of 50, 100, 200, 400, and 800 rad. The relative biological effectiveness (RBE) of 14.1 MeV fast neutrons, gamma-rays (^{60}Co), and mixed rays required to produce mild disturbances that resulted in permanent changes in the crystalline lenses of young albino rabbits at the end of 20 weeks was 2, 1, 1 respectively when compared with 180 kV x rays, while that needed to produce permanent changes and cause such severe disturbances as possible decreased vision was calculated to be 2, 1, and incalculable. The RBE at the end of 40 weeks was 8, 1, and 2 respectively for mild disturbances that resulted in permanent changes, while that needed to produce permanent changes and cause the severe disturbance of possible decreased vision was calculated to be 2, 1, and 1. The RBE at the end of 60 weeks was 8, 1 to 2, and 2 respectively for mild disturbances that resulted in permanent changes, while that needed to produce permanent changes and cause such severe disturbances as possible decreased vision was calculated to be 2, 1, and 1 respectively. (auth)

45865 EFFECT OF IRRADIATION ON THYROID GROWTH IN MOUSE FOETUSES AND GOITROGEN CHALLENGED ADULT MICE. Walinder, G.; Sjoeden, A.-M. (Foersvarets Forskningsanstalt, Stockholm). Acta Radiol., Ther., Phys., Biol.; 10: No. 6, 579-92(Dec 1971).

The radiosensitivity of the goitrogen challenged thyroid gland was investigated in fetal and adult mice both after irradiation with ^{131}I accumulated in the gland and after x irradiation. The similar effect in the normally growing thyroid in the fetuses and young mice and the goitrogen-stimulated adult animals suggested that the rate of thyroidal growth rather than the age of the mouse was the decisive factor in determining the degree of the reaction. X irradiation proved to be two to four times more effective than internal irradiation with ^{131}I. (auth)

45866 ACUTE DEATH OF MICE IRRADIATED WITH PULSED X-RAYS FROM A LINEAR ACCELERATOR. Antoku, Shigetoshi; Takeshita, Kenji (Hiroshima Univ.). Hiroshima Daigaku Genbaku Hoshano Igaku Kenkyusho Nenpo; No. 12, 63-8(1971). (In Japanese).

The comparative lethal effects on mice of 25 MeV pulsed x rays from a linear accelerator and ^{60}Co gamma rays were studied. The $LD_{50(30)}$ of mice for pulsed x rays and ^{60}Co gamma rays was 809 rads and 902 rads, respectively. According to this biological response, the relative biological effectiveness (RBE) of pulsed x rays to ^{60}Co gamma rays was 1.1. The patterns of daily mortality and body weight changes of mice irradiated with pulsed x rays were similar to those irradiated with ^{60}Co gamma rays. These facts indicated no qualitative differences in biological effects between pulsed and sustained radiations. However, it is necessary to study dose rate effects in various biological materials, because significant differences have been reported for intestinal and cerebral deaths between pulsed and sustained radiations. (auth)

45867 STATISTICAL ANALYSIS OF RADIOINDUCED ABNORMAL DEVELOPMENT. Satow, Yukio; Miyabara, Shinichi; Ikeda, Takayoshi; Ueno, Takehisa (Hiroshima Univ.). Hiroshima Daigaku Genbaku Hoshano Igaku Kenkyusho Nenpo; No. 12, 190-6(1971). (In Japanese).

The irradiation of pregnant rats with 80 to 150 rad of 14.1 MeV fast neutrons at 7 to 11 days after conception induced malformations of the hearts and blood vessels in the fetuses. In this study some methods were carried out such as regression analysis or variance analysis to examine the relation between the malformation rate in the fetuses and the date or the dose of irradiation. Although the malformations are induced by the synthetic effects of the dose and date of irradiation, the results showed that the malformation rate depended on the date, rather than dose, suggesting the importance of "sensitive periods" for the abnormal development. The data obtained from previous experiments indicate that irradiation with the dose of 130 rad of neutrons at 8 days after conception was most effective to induce the cardiovascular anomalies. In other words, the irradiation of 130 rad at 8 days after conception induced a high incidence of the anomalies with low incidence of absorption of the embryos. The analysis of the relation between the anomaly and absorption using the X^2-test or experimental formula was carried out on this data. It was proved that there were some significant differences between anomalous and absorbed rate. (auth)

45868 RIBONUCLEIC ACID SYNTHESIS AND IONIZING RADIATION. Olkowski, Z. (Silesian Medical Academy, Katowice, Poland). Postepy Astronaut.; 4: No. 4, 67-71(1970). (In Polish).

The subject of these studies was the motoneurons of spinal cords of mice in acute radiation sickness. The synthesis of RNA was studied by autoradiography using ^{3}H-uridine. Besides the following enzymes, connected with RNA metabolism, were studied cytochemically: glucose-6-phosphate, 6-phosphogluconate and succinate dehydrogenases according to Pearse, adenosine-3-phosphatase according to Wachstein and Meisel, thiamine pyrophosphatase nucleosidediphosphatase according to Novikoff, Goldfisher, and Essner. It was shown, that the ionizing radiation inhibits RNA synthesis both in the cell nucleus and cytoplasm and inhibits the activity of investigated enzymes. The changes in the enzyme activity and localization are compared with the events that occur in incorporation of ^{3}H-uridine in experimental and control animals. (NSA of Poland)

45869 SENSITIZATION OF HYPOXIC CELLS IN VIVO WITH TRIACETONEAMINE N-OXYL (TAN). Hornsey, S. (Hammersmith Hospital, London). Int. J. Radiat. Biol.; 22: No. 1, 91-4(Jul 1972).

Female mice were whole-body irradiated with 7 MeV electrons from the MRC Linear Accelerator, over a dose range of 2400 to 3600 rads while breathing N_2 and over a dose range of 1200 to 1300 rads while breathing O_2. Counts were made of the number of survivors 5 days after irradiation. Animals given non-toxic intraperitoneal injections of triacetoneamine N-oxyl (TAN) at a rate of 0.238mg TAN/g mouse 5 min before irradiation while breathing N_2 were more sensitive than animals given no TAN. The dose modifying factor was 1.08. Animals given TAN 20 min before irradiation, while breathing N_2, showed the same sensitivity as animals without TAN. TAN given to animals 5 min before irradiation while breathing O_2 had no effect on their sensitivity. (UK)

45870 RADIATION EFFECTS ON THE BONE GROWTH AND EFFECTS OF SALIVARY GLAND HORMONE (PAROTIN) ON IRRADIATED BONE TISSUES. Iwasaki, Zensuke (Iwate Medical Coll., Morioka, Japan). Nippon Igaku Hoshasen Gakkai Zasshi; 31: No. 1, 78-95(Apr 1971).

Single irradiation doses of 5,000 R, 2,000 R, and 1,000 R, respectively, were administered to three groups, the whole hind limbs (Group WB), the epiphysis alone (Group E), and the diaphysis alone (Group D), of Wistar rats aged one month or 3 months. An injection of 0.1 mg/kg of parotin was given twice a week over 24 weeks (Group P). Measurements by x-ray pictures were performed after irradiation. In the 1st, 3rd and 6th months after irradiation, the animals were sacrificed and the left hind leg was resected for histopathological examination. The younger the animals were and the larger the dose was, the more intensely the radiation disturbance in the bone appeared. The degree of disturbance was the highest in Group WB, followed by Group E and was the most mild in Group D. In the young rats aged one month, a growth retardation of the tibia was observed in the group irradiated with 1,000 R and was the mildest disturbance in comparison to the contrast group, the growth rate of the tibia 6 months after irradiation being 86.4% in Group WB, 89.7% in the Group E, and 95.5% in Group D. Therefore, the lower limit for manifestation of disturbance was estimated to be below 1,000 R. In Group P, in case of irradiation with 1,000 R, the arrangement of the cells in the epiphyseal cartilage was more regular than the group with irradiation alone and disappearance and necrosis of the nucleus of cartilaginous cells were less. There was no great difference from the control group in extension of the calcification layers and the number of osteocytes, showing an effect of reparation of distur-.

bance to some degree. In the irradiated groups with more than 2,000 R the disturbance was greater not allowing for the effect of parotin. (Japan)

45871 STEM CELL RENEWAL IN SPLEEN AND BONE MARROW OF MICE AFTER REPEATED TOTAL-BODY IRRADIATIONS. Vos, O. (Rijksverdedingsorganisatie TNO, Rijswijk, Netherlands). Int. J. Radiat. Biol.; 22: No. 1, 41-50 (Jul 1972).

To study the effect of repeated sublethal irradiations on the multiplication of haemopoietic stem cells, mice were irradiated one, two, or three times with an x-ray dose of 440 rads. The time-interval between the first and the second irradiation was 7 days. When three irradiations were given, the interval between the last two exposures varied between 7 and 100 days. The growth-rate of CFU's in femoral bone-marrow after two irradiations was slower than after one irradiation; at around the 15th day the overshoot in the spleen was smaller after two irradiations than after one. These findings were even more pronounced when a third dose was given within a few weeks after the second. When the third dose was given longer than 5 weeks after the second, the CFU growth curve in bone-marrow and spleen was closer to the curve obtained after one irradiation. The significance of the findings in respect of the capacity of stem cells for self-renewal is discussed. (auth)

45872 EFFECTS OF DIETARY ANTIOXIDANTS ON LIPID PEROXIDE FORMATION IN ANIMAL TISSUES AFTER WHOLE-BODY IRRADIATION. Dawes, E. A.; Wills, E. D. (Saint Bartholomew's Hospital, London). Int. J. Radiat. Biol.; 22: No. 1, 23-40(Jul 1972).

Rates of lipid peroxidation in mouse-liver homogenates increased linearly with dose 24 hr after whole-body x irradiation (500 to 2000 rads), and reached a maximum 3 days after irradiation. Smaller increases in the rates of peroxidation occurred in heart, kidney, or spleen homogenates. Vitamin E supplementation of the diet depressed the rate of lipid peroxidation in liver, heart, spleen, and kidney homogenates after irradiation with 1000 to 2000 rads. Hydroperoxide and malonaldehyde increased significantly in spleen lipids after irradiation but much smaller changes occurred in heart or liver lipids. Dietary vitamin E inhibited increase of malonaldehyde but had little effect on hydroperoxide increases. Dietary BHT (2,6-di-tert-butyl-p-cresol) was less effective than vitamin E but depressed the rate of peroxidation in liver homogenate and microsomal fraction. In the liver microsomal fraction, the maximum rate of peroxidation and minimum antioxidant concentration occurred concurrently. Tissue and subcellular antioxidant concentrations are considered to play a major role in regulating the rate of lipid peroxidation after irradiation. (auth)

Invertebrates

Refer also to abstract: 45724.

45873 (TID-26078) EFFECTS OF GAMMA RADIATION ON THE SPECTRAL SENSITIVITY OF THE NOCTUID MOTH, HELIOTHIS ZEA. Baker, James F. (Florida State Univ., Tallahassee. Coll. of Arts and Sciences). Jun 1972. 14p. Dep. NTIS.

Ionizing radiations, such as x rays, beta rays, and gamma rays, can evoke a visual response in many organisms. In the noctuid moth, Heliothis Zea, constant rates of exposure to gamma radiation were shown to act in a manner similar to appropriately chosen levels of ambient illumination in the visible range (400 to 700nm). This study investigates the effects of gamma radiation on the spectral sensitivity of Heliothis Zea. If gamma rays were to depress visual sensitivity differentially with respect to wavelength, they would be acting in a manner analogous to selective chromatic adapting stimuli as observed in organisms with more than one visual pigment. Gamma radiation was found to depress visual sensitivity equally, as measured by the ERG response, regardless of wavelength, suggesting that Heliothis Zea does not have two or more populations of visual receptors with different pigments. (auth)

45874 NUCLEAR-CYTOPLASMIC RELATIONS IN THE MITOSIS OF SEA URCHIN EGGS. III. gamma-RAY-INDUCED DAMAGE TO WHOLE EGGS AND NUCLEATE AND ANUCLEATE HALF-EGGS. Rustad, Ronald C.; Yuyama, Shuhei; Rostad, Lynne C. (Case Western Reserve Univ., Cleveland). J. Cell. Biol.; 49: No. 3, 906-12(Jun 1971).

Sea urchin eggs were cut into halves. The nucleate and anucleate halves and whole eggs were γ irradiated and then fertilized with normal sperm. The first mitosis of the diploid half-egg was more delayed than the division of the whole egg. There was a small, but highly significant, delay of the mitosis of the haploid half-egg, thus demonstrating cytoplasmic sensitivity to ionizing radiation. Since the sensitivity of nucleate cells is influenced by cytoplasmic volume, the problem of the role of cytoplasm in repair is considered in relation to these data and other reports in the literature. (auth)

45875 HISTOPATHOLOGY OF IRRADIATED YELLOW MEALWORM ADULT AND LARVAL MIDGUTS. Brower, John H.; Ashraf, Mohammad (Dept. of Agriculture, Savannah). Ann. Entomol. Soc. Amer.; 65: No. 4, 950-4(Jul 1972).

Gamma radiation doses of 5 to 100 kilorads had a pronounced effect on the midgut of both larval and adult yellow mealworms, Tenebrio molitor L. (Coleoptera: Tenebrionidae). Degenerative changes were positively correlated with both dose and time elapsed after exposure. The regenerative cells that renew the epithelial lining of the midgut were particularly sensitive to radiation damage; the damage eventually resulted in loss of the midgut epithelium. (auth)

45876 DIFFERENCES IN SYNAPTIC AFFINITY OF CHROMOSOME ARMS OF DROSOPHILA MELANOGASTER REVEALED BY DIFFERENTIAL SENSITIVITY TO TRANSLOCATION HETEROZYGOSITY. Roberts, Paul A. (Oregon State Univ., Corvallis). Genetics; 71: No. 3, 401-15(Jul 1972).

The chromosome arms of Drosophila melanogaster differ in the degree to which translocation heterozygosity suppresses crossing over both regionally, and as whole arms. Using x-irradiated flies, the region of maximum sensitivity to structural heterozygosity in each arm of the long autosomes $\frac{1}{3}$ to $\frac{1}{2}$ the length of the arm in from the tip was identified. The regional differences are interpreted as being further indication that synapsis usually begins distally, but not at the telomeres. The different sensitivity of arms 3R, 2R, 3L, and 2L (ranked in order of increasing sensitivity) is evidence of intrinsic differences in the synaptic affinity of chromosome arms. (auth)

45877 MODIFICATIONS INDUCED BY GAMMA IRRADIATIONS IN THE OVIPOSITION OF WORKERS AND FEMALES OF THE ANT DOLICHODERUS QUADRIPUNCTATUS. Torossian, C.; Causse, R. (Faculte des Sciences, Toulouse. INRA, Montfavet, France). Ann. Zool.-Ecol. Anim.; 3: No. 4, 427-41(1971). (In French).

Experiments on workers of D. quadripunctatus exposed to various doses of gamma rays result in reducing the fecundity and in a final sterility. Females of the same species subjected to gamma radiations offer a great resistance, and their mortality for doses of median value (5000 to 50,000 rads) remains low; nevertheless their longevity is shortened, especially for doses above 50,000 rads. The fecundity of these females is lowered to a residual level, all the eggs laid being abortive. A further series of experiments was made to disturb the balance in the ant society between female and workers. When only the queen is irradiated, the workers begin to lay eggs, even when the queen is still laying eggs. Irradiation with low doses resulting in sterile workers, followed by the introduction of young larvae, induces the production of workers, of females and of some winged females. (auth)

45878 FECUNDITY AND LONGEVITY OF F_1 FEMALES OF HABROBRACON FROM SPERM X-RAYED WITH 3000 r. Heidenthal, Gertrude (Russell Sage Coll., Troy, N. Y.); Nelson, Wayne; Clark, Leonard. Genetics; 71: No. 3, 349-65(Jul 1972).

The fecundity and longevity of two groups of F_1 diploid virgins of Habrobracon the fathers of which were x rayed with 3000 R were compared. Sorting of wasps into two groups was based on low or high hatchability of their F_2 haploid eggs. Wasps with low hatchability (below 60%) are heterozygous for induced embryonic lethals such as recessives and translocations; wasps with high hatchability (100 to 60%) are free of lethals or possibly heterozygous for mild detrimentals. The F_1s showing high hatchability laid significantly more eggs on the average; the average difference in lifespan was almost statistically significant (7% level). A more sensitive analysis by regression indicated a highly significant linear regression of survival of all F_1s on hatchability of their eggs: F_1s whose eggs showed 100% hatchability. Furthermore, the former laid 4.99 more eggs on the average than the latter. The data also showed a very highly significant positive correlation coefficient between eggs laid and survival of mothers (0.122) and a very highly significant positive partial correlation coefficient (0.105) with hatchability held constant. The latter indicates that the F_1s that laid more eggs also lived longer, regardless of the hatchability of their eggs and hence of the heterozygosity of the mothers for lethals and other detrimentals. (auth)

45879 INFECTIVITY AND DEVELOPMENT OF X-IRRADIATED METACERCARIAE OF LEUCOCHLORIDIOMORPHA CONSTANTIAE (TREMATODA) IN THE CHICK AND ON THE CHORIOALLANTOIS. Fried, Bernard; Davis, James E. (Lafayette Coll., Easton, Pa.). Trans. Amer. Microsc. Soc.; 91: No. 2, 208-12(Apr 1972).

Infectivity and development of L. constantiae metacercariae x-irradiated at 500 to 20,000 R were studied in the bursa of Fabricius of the chick and on the chorioallantois. X-irradiation significantly affected infectivity in the chick and on the chorioallantois. Control flukes and those irradiated up to 2,000 R were ovigerous. Egg development was suppressed at 3,000 R and postmetacercarial development did not occur at 5,000 to 20,000 R. Radiation did not affect pairing or clustering of worms in the bursa or on the chorioallantois. (auth)

45880 NEW METHOD FOR THE QUANTITATIVE STUDY OF INDUCED AUTOSOMAL NON-DISJUNCTION IN DROSOPHILA MELANOGASTER. Clark, A. M.; Sobels, F. H. (Univ., Leiden). Genen Phaenen; 15: No. 1, 29-30(Jun 1972).

A new method for determining the relative frequency of non-disjunctional progeny in Drosophila melanogaster was developed. The dose-effect relationship was studied for the induction by x rays of non-disjunction of the second chromosome in stage 7 oocytes; no significant departure from linearity was observed over a range of exposures from 250 to 3000 R. Thus no evidence for a threshold, even at the low exposure dose of 250 R was obtained. (H.L.W.)

45881 CLONAL PARAMETERS OF TERGITE DEVELOPMENT IN DROSOPHILA. Garcia-Bellido, A.; Merriam, J. R. (CSIC, Madrid. Univ. of California, Los Angeles). Develop. Biol.; 26: 264-76(Oct 1971).

A clonal analysis of abdominal development in Drosophila was carried out using cell marker mutants. The uncovering of these recessive markers in heterozygous individuals occurred after spontaneous loss of a X ring chromosome (gynandromorphs) or by somatic recombination induced at different developmental stages by 1000 R of x-ray. The minimum spot sizes resulting from preblastodermic gynandromorphs indicate that the least number of primitive anlage cells is about 8. This is also the number of imaginal cells per anlage present throughout the larval stages of development. Only with the onset of metamorphosis do the imaginal cells start dividing and spreading over the presumptive tergite area, each pair of bilateral anlage giving rise to a complete tergite. All the tergites studied (II-VI) behaved uniformly in the present experiments. Corresponding with the constant number of imaginal cells during the larval development there is a constant frequency of induced spots or a constant cell sensitivity to SCO. This sensitivity varies depending on the chromosome considered, being higher in the X chromosome than in the 3L chromosome arm. The data on gynandromorphs, as well as those of somatic spots, indicate that the adult tergites have an indeterminate pattern of growth. The cell determination to become trichome or micro- or macrochaeta occurs sometime during the pupal expansion of the growing imaginal cell population. Trichome- and chaeta-forming cells may then be separated to construct the adult cuticular pattern. (auth)

45882 ROLE OF THIOLS IN THE RADIOSENSITIVITY OF SEA URCHIN EGGS. Smirnova, I. B.; Latsis, R. V. (Inst. of Biological Evolution, Moscow). Dokl. Akad. Nauk SSSR; 203: No. 1, 254-6(1 Mar 1972). (In Russian).

The change in radiosensitivity of sea urchin eggs and their content of SH-compounds at various stages of mitosis during the first three weeks of cleavage were studied. Experiments were conducted on artificially fertilized mature eggs of the sea urchin developing at 19 to 21°C in fresh sea water. Doses of 1,500 R of x rays were administered at different stages of mitosis, and the survival rate of the embryos was obtained. Eggs irradiated during the metaphase exhibited the greatest survival rate; survival was lowest among the telophase-prophase-irradiated. The metaphase was also richest in thiol content; the telophase-prophase was poorest. A 1% solution of ether in water was employed as a holding agent for temporarily stopping mitosis, for making comparisons in ensuing development. Sufficient correlation was then possible to suggest that the change in radiosensitivity during the course of embryogenesis was associated with a fluctuating level of endogenic thiols. (K.S.W.)

45883 EFFECT OF IONIZING RADIATION ON THE STABLE FLY, STOMOXYS CALCITRANS (LINNAEUS). White, Sheldon Andrew. Gainesville, Fla.; Univ. of Florida (1971). 147p. University Microfilms Order No. 72-16,670.

Thesis.

The stable fly is an important economic pest that requires continual and costly control measures. Eradication of this pest would be a far more worthwhile goal. The ultimate objective of this investigation was to determine if radiation-sterilization of stable fly pupae could produce males that would be of practical value in a sterile-male-release program. During this investigation, flies were irradiated with either 1000 R, 1200 R, 1500 R, 1750 R, or 2000 R of gamma radiation as 48-, 72-, 96-hour-old pupae. The effects of these dosages on eclosion, reproduction, and longevity of stable flies were determined. The results indicated that, regardless of the age of pupae when irradiated, apparently none of the dosages adversely affected the time at which maximum adult eclosion occurred, the percent eclosion, or the ratio of males to females produced in each age group. The effect of gamma radiation on oviposition was dependent upon the age of the pupae when irradiation occurred. Females irradiated as 48-hour-old pupae failed to oviposit when treated with 1250 R. In those exposed as 72-hour-old pupae, oviposition was completely inhibited at 1750 R dosage level. Oviposition in females irradiated as 96-hour-old pupae was completely inhibited by a dosage of 2000 R. Oviposition in untreated females was both reduced and delayed when mated with males irradiated with 1500 or more roentgens as 48-hour-old pupae. This did not occur when untreated females were crossed with treated males irradiated as 72- or 96-hour-old pupae. Percent sterility in treated males and females, crossed with untreated flies, increased as radiation dosage increased. In the 48-hour-old age group, complete sterility in females occurred at 1250 R, while male sterility was complete at 1500 R. Complete sterility in females irradiated as 72- or 96-hour-old pupae occurred at a dosage of 1750 R. Virtually complete sterility in males from both age groups occurred at 2000 R. With few exceptions, the mean longevity of treated flies within an age group decreased as radiation increased. Further, longevity increased as the age of the pupae at irradiation increased. Longevity was most severely affected in flies irradiated as 48-hour-old pupae. Further, flies from this age group were apparently intolerant to cold and demonstrated severe wing deformations when exposed to dosages exceeding 1250 R. The mean longevity of males treated with 2000 R as 72- or 96-hour-old pupae was 9.8 and 17.0 days, respectively. The latter treatment produced males that were fully competitive with untreated males in each of the five mating competitiveness ratios tested. The results of these tests apparently indicate that, unless the age of pupae can be determined, the use of sterilized pupae in a successful stable fly sterile-male-release program will be limited. Pupation must be highly synchronous to achieve efficiency in mass-rearing and to facilitate the proper timing of the appropriate sterilizing dosage. Two methods for achieving synchronous pupation in stable flies are suggested. The results of sterility, longevity, and mating competitiveness tests appear to indicate that males exposed to 2000 R gamma radiation as 96-hour-old pupae are satisfactory in every respect for use in a sterile-male-release program for stable fly population control. A method for obtaining these flies from a mixed age group of pupae is suggested. (Diss. Abstr. Int., B)

45884 EFFECTS OF GAMMA RADIATION ON THE RESPIRATION OF ACARUS SIRO. Hemenway, Robert Clark, Jr.; Davis, Robert (Univ. of Georgia, Athens). J. Ga. Entomol. Soc.; 7: No. 2, 140-51(Apr 1972).

The rate of oxygen uptake was determined for adult male and female, tritonymphal, and protonymphal stages of the grain mite, Acarus siro L., following exposure to gamma radiation doses of 0, 5, 15, 25, 50, and 100 krad. Respiratory rates were measured at temperatures of 15 and 30 C. The results seem to indicate a higher rate of oxygen consumption following exposure to a dose of 25 krad. In mites tested at 15 C, significant stimulation of oxygen consumption was observed only at 25 krad. In mites tested at 30 C, significant depression in oxygen consumption was observed at 5, 50, and 100 krad. Oxygen consumption was examined per individual mite and as a function of body weight. When individual mites were compared, females used the most oxygen, followed in descending order by males, tritonymphs, and protonymphs. Differences in oxygen consumption among life stages were less pronounced when comparisons were made on the basis of body weight. All stages exhibited increased oxygen consumption when the temperature was increased from 15 to 30°C. However, the proportional increase in oxygen uptake in females was not as great as in other stages. (auth)

45885 EFFECT OF ^{137}Cs RADIATION ON GROWTH, DEVELOPMENT, AND MORTALITY OF THE LARVAE OF THE TUSSOCK MOTH, HEMEROCAMPA LEUCOSTIGMA. Rossmoore, H. W.; Hoffman, E. A. (Wayne State Univ., Detroit). J. Invertebr. Pathol.; 17: No. 2, 277-81(Mar 1971).

Larvae and pupae of Hemerocampa leucostigma were irradiated in a ^{137}Cs γ source and observed for effects on growth, development, and mortality. Irradiated larvae were half of control weight 10 days postradiation. Although pupae were extremely resistant, relatively low doses to larvae prevented emergence. LD_{100} of first instars was 30 kR, while that of third instars was 85 kR. No delay in median time to pupation was noted. (auth)

45886 DISINFECTING MITE INFESTED HAM BY IONIZING RADIATION. Diehl, J. F. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Fleischwirtschaft; 52: No. 1, 81(Jan 1972). (In German).

Ham infected by mites was irradiated with 10 MeV electrons. A radiation dose of 200 krad destroyed the mites in all stages of development. This dose caused no changes in sensory properties during a storage period of 3 months. (auth)

45887 ENHANCING EFFECT OF LUCANTHONE (MIRACIL D) ON THE FREQUENCY OF X-RAY-INDUCED CHROMOSOME LOSS IN DROSOPHILA MALE GERM CELLS. U, Raymond (Duke Univ., Durham, N. C. Veterans Administration Hospital, Durham, N. C.). Mutat. Res.; 14: No. 3, 315-24(Mar 1972).

The effect of lucanthone (miracil D), an inhibitor of RNA synthesis, plus x-irradiation on Drosophila melanogaster males $X^{c^2}yB/Ysc^{8}y^{+}$ and on the subsequent production of chromosome loss via breakage has been investigated. Lucanthone feeding plus 495 R induced a significantly higher frequency of chromosome loss when irradiation was given in three equal fractionated doses at 3-h intervals than the same dose given acutely. On the other hand, the difference in frequency of non-disjunctional females was not significant. The enhancing effects of this chemical were found only in the fractionated series but were absent in acute x-irradiation series. This effect was found primarily in those cells in spermatid and spermatocyte stages at the time of irradiation. A pertinent point of interest presented was that not only protein synthesis but also RNA synthesis may play a significant role in the development of radiation damage and in postradiation repair processes at the chromosomal level, since inhibition of RNA synthesis may eventually inhibit protein synthesis. (auth)

Radionuclide Effects (Internal Source)

Man

Refer also to abstract: 45905.

45888 (CONF-720520-1) PATHIOPHYSIOLOGY AND DIAGNOSIS OF INTERNAL CONTAMINATION. Lincoln, T. A. (Oak Ridge National Lab., Tenn.). 1972. 14p. Dep. NTIS.

From Medical planning and care in radiation accidents seminar; Oak Ridge, TN. (21 May 1972).

The hazards from internal irradiation following the uptake of radioisotopes by man are reviewed. It is pointed out that the most serious consequence of radioisotope uptake is the development of neoplasms but, since it may take years for this effect to be manifest, a large exposure at age 55 may be of little consequence in relation to life expectancy while exposure at age 25 may lead to neoplasia within the lifetime of the individual. The possible impact on public health in the event of increased amounts of Pu being released to the environment as a consequence of the expansion of the nuclear power industry is considered. It is pointed out that during the past 25 years no cancers have been reported in personnel working with Pu. Data are reviewed from studies on dogs and rodents that show the development of bone sarcomas and lung carcinomas following the inhalation or injection of ^{239}Pu. The lowest lung burden associated with neoplasm induction in dogs was .05 μCi at death nine years following exposure. Data on the occurrence of neoplasms in man following the injection of Ra showed no cases occurring at doses below 1200 rads. Animal studies have shown Pu to be 5 to 10 times as effective for neoplasm induction as Ra. This would indicate the threshold dose for neoplasm induction by Pu in man is between 50 and 200 rads. The relevance of animal data for estimation of the radiation response of man is discussed. Methods for the evaluation of the radiation dose to personnel following the uptake of ^{239}Pu or ^{241}Pu are discussed briefly. The importance of saving all urine and feces for radiometric analysis and of whole-body counting is emphasized. (C.H.)

45889 LYMPHOCYTE STIMULATION BY THYROGLOBULIN AFTER LOCAL IRRADIATION OF THE THYROID GLAND IN MAN. Einhorn, N.; Packalen, T.; Wasserman, J. (Karolinska Sjukhuset, Stockholm. Sjukvardsstyrelsens Bakteorologiska Centrallaboratorium, Stockholm). Acta Radiol., Ther., Phys., Biol.; 10: No. 5, 481-7(Oct 1971).

Lymphocyte stimulation by thyroglobulin was investigated in 46 cases of hyperthyroidism before and after local irradiation of the thyroid gland by ^{131}I. A statistically significant increase in the stimulation occurred at six weeks to three months. (auth)

Animals

Refer also to abstracts: 45814, 45819, and 45865.

45890 (NYO-3970-29) ENVIRONMENTAL RADIOACTIVITY: RADIATION EFFECTS AT THE CELLULAR LEVEL. Fabrikant, Jacob I. (Johns Hopkins Univ., Baltimore, Md. Dept. of Radiology). [nd]. Contract AT(30-1)-3970. 71p. Dep. NTIS.

The effects of internally deposited radioisotopes on man are not well understood, primarily because of the nonuniformity of dose distribution throughout the body, the heterogenous composition of the various energies from radiations of different LET, and the biological variability in the rate of excretion of the radioisotopes and their daughter products. Data are reviewed from laboratory studies on mammals, primarily on mice, on the effects of internal irradiation on cells in various tissues. These studies provide evidence that during protracted radiation exposure the cells in rapidly renewing cell populations, such as bone osteoblasts, hematopoietic tissues, and epithelial linings of periosteal and endosteal membranes, are subject to radiation injury, depopulation, and regeneration and those cells with the greatest proliferative potential are most subject to radioinduced neoplasia. Data indicate that all ionizing radiations induce the same biological effects but the radiation injury may be distributed throughout the body in different ways, depending on the properties of the radiation and the chemical nature of the emitter. There is abundant evidence that the delayed mutagenic effects from internal emitters are similar to those observed following exposure to external radiation sources. Applications of this data to the prediction of the hazards to public health in the event of an increase in the levels of radioisotopes in the environment are considered. (C.H.)

45891 (ORO-2690-12(Pt.B)) RESEARCH PROPOSAL. Annual Report No. 12, Part B: September 1, 1971-August 31, 1972. (Florida State Univ., Tallahassee. Inst. of Molecular Biophysics). 1 Jun 1972. Contract AT(40-1)-2690. 75p. Dep. NTIS.

Separate abstracts were prepared on four sections of this report. Additional sections discuss RNA metabolism in eukaryotic organisms, the biological significance of tRNA modifications, effects of electronic interactions on molecular excitation processes, and physical production and detection of singlet oxygen in model biological systems. A list is included of publications during the report period. (H.L.W.)

For abstracts of individual sections see: 45817 and 45892-45894.

45892 (ORO-2690-12(Pt.B), Paper 4) BIOLOGICAL TOXICITY OF INTRACELLULAR RADIOISOTOPE DECAY BY BETA EMISSION AND ELECTRON CAPTURE. Hofer, K. F. 3p.

Lymphoid leukemia cells were labeled with various doses of ^{125}I-iododeoxyuridine, ^{131}I-iododeoxyuridine, or ^{3}H-thymidine and inoculated into new, nonradioactive hosts to facilitate evaluation of toxic effects resulting from the intranuclear decay of the three radioisotopes. Based on radioisotope incorporation data, number of tumor cells present at the time of labeling, labeling fraction, and nuclear diameter of cells, the rate of intracellular energy deposition per labeled cell was calculated from the known decay properties of each isotope. The toxic manifestations of ^{125}I exceeded the effects of tritium and ^{131}I by a factor of 12 to 15. Theories to explain the excessive toxicity of intranuclear ^{125}I are discussed; the theories are based on the fact that the electron capture decay of ^{125}I is accompanied by the release of Auger electrons. (H.L.W.)

45893 (ORO-2690-12(Pt.B), Paper 13) SPECIAL BIOPHYSICS PROJECTS. Smith, J. Marshall. 3p.

Studies on the biophysical evaluation of the radiotoxicity of intracellular ^{125}I are discussed. The unusually high radiotoxic effect of DNA-associated ^{125}I is pointed out. Progress is reported on investigations for determining the consequences of electron capture decay of ^{125}I and the radiolysis of labeled DNA. A theoretical analysis of the microdosimetry of the Auger effect in a DNA-H_2O matrix is being made. Progress is also reported on the development of a scanning electron microscope for the detection and mapping of trace elements in biological specimens. (H.L.W.)

45894 (ORO-2690-12(Pt.B), Paper 14) CHROMOSOMES OF EUKARYOTES: REGULATION OF DNA REPLICATION, ORGANIZATION AND INTEGRATION OF DNA AND EFFECTS OF THE DECAY OF INCORPORATED ISOTOPES (^{3}H AND ^{125}I). Taylor, J. Herbert. 3p.

Studies on organizational properties of the genome and the regulatory systems which normally operate in cells are being conducted in order to increase understanding of radiation damage and repair as well as evaluation of long-term effects of other mutagenic agents. Four functional units of DNA were identified and these are described. Studies on replicating segments of DNA were conducted using pulse-labeled cells. Electron microscope studies of partially melted DNA revealed small regions separated by 0.3 to 0.5 μ in contour length with quite low melting points. A study of the relative efficiencies of incorporated ^{3}H and ^{125}I in breaking DNA was initiated. Neither isotope was observed

to produce double-chain breaks, but both produced single-chain breaks with relatively high efficiencies. (H.L.W.)

45895 (UR-3490-102) PATHOGENESIS OF RADIONUCLIDE-INDUCED TUMORS. Casarett, George W. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). [nd]. 25p. (CONF-720505-4). Dep. NTIS.

From twelfth Hanford biology symposium on radionuclide carcinogenesis; Richland, WA. (11 May 1972).

A review is presented of carcinogenic mechanisms and radio-induced carcinogenesis following the uptake of radioisotopes by experimental animals. Discussions are presented of the pathological changes occurring during induction of the following classes of tumors: pituitary and thyroid tumors induced by ^{131}I; bone tumors induced by ^{90}Sr, ^{226}Ra, ^{228}Ra, ^{239}Pu, and ^{228}Th; lung tumors induced by ^{210}Po, ^{239}Pu, ^{238}Pu, $^{232}ThO_2$, ^{198}Au, ^{59}Fe, ^{35}S, ^{32}P and ^{144}Ce; tumors of the gastrointestinal tract induced by ^{137}Cs, ^{95}Nb, ^{144}Ce, ^{90}Y, and ^{106}Ru; liver tumors induced by $^{232}ThO_2$ and ^{239}Pu; and kidney tumors induced by ^{210}Po. (H.L.W.)

45896 HEMATOPOIETIC AND IMMUNOLOGICAL ALTERATIONS IN MICE PRODUCED BY ^{89}Sr-INDUCED MARROW HYPOPLASIA. Gurney, C. W.; Klassen, L.; Birks, J.; Allen, E. (Univ. of Kansas, Lawrence). Exp. Hematol.; 22: No. 1, 27-30(Mar 1972).

Results are summarized from a number of experiments utilizing intraperitoneally injected ^{89}Sr to produce destruction of bone marrow cells in mice. This method offers promise for a variety of hematologic and immunologic investigations. (H.L.W.)

45897 RADIATION-INDUCED TRANSPLANTABLE MYELOMONOCYTIC LEUKEMIA IN BEAGLES: HEMATOLOGIC PARAMETERS. Wilson, F. D.; Shifrine, M. (Univ. of California, Davis). Exp. Hematol.; 22: No. 1, 41-4(Mar 1972).

A radiation-induced canine disease resembling myelomonocytic leukemia in man was serially transplanted to fetal puppies using viable tumor cells. A sequence of alterations in neoplastic expression was observed with repeated transplantations. In the earliest recipients the disease closely resembled that in the original donor dog and was characterized by myelomonocytic morphology and frank leukemic manifestations in peripheral blood. With further transplantation, the monocytic component became less apparent, and the disease appeared as a more pure granulocytic leukemia. In later passages, the leukemic signs in peripheral blood were lost (aleukemic leukemia). Evidence for decreased bone marrow involvement was seen in the last group of recipients. All puppies had normal myeloid: erythroid ratios although marrow values continued to show significant elevations in percentages of blasts and primitive granulocytes. Concurrent with peripheral blood and bone marrow changes there was a relative increase in a tendency for chloromatous tumor involvement with subsequent passages. This finding suggests the tendency for malignant cells to adapt to an ascitic environment. (auth)

45898 INCREASED ANDROGEN PRODUCTION IN FISH FOLLOWING IRRADIATION. Rathi, S. K. (Univ. of Rajasthan, Jaipur, India). Sci. Cult. m(Calcutta): 37: No. 12, 583-4(Dec 1971).

Phosphorus-32 was administered internally to immature male Heteropneustes fossilis and controls were given an equal dose of stable H_3PO_4. Ten days later the seminal vesicles of the irradiated fish exhibited a 34% increase in weight and hypertrophy was observed in histological preparations. These changes were attributed to an increased production of androgen. There was no change in the seminal vesicles of the control fish. (H.L.W.)

45899 HYGIENIC INVESTIGATION ON CONSUMPTIBILITY OF IRRADIATED COMPLETE RAT FEED. Barna, J. (Kozponti Elelmiszeripari Kutato Intezet, Budapest). Izotoptechnika; 15: No. 3 3-4, 217-24(1972).

Malignant or pathological effects or changes in weight increase, organ weight, feed consumption, number of descendants, and blood picture of rats fed with LATI feed irradiated with 2.5 and 4.5 Mrad, respectively, could not be observed. (auth)

45900 EFFECTS OF ^{90}Sr AND ^{137}Cs ADMINISTERED CONTINUOUSLY UPON MICE. VIII. ABNORMALITY OF REPRODUCTIVE FUNCTION. Nishio, Kazuo. Annu. Rep. Radiat. Center Osaka Prefect.; 12: 111-12(1971).

Reproduction of mice administered continuously with ^{90}Sr and ^{137}Cs through drinking water was observed with regard to litter size and reproduction-span (period between 1st and last birth). Propagation of mice was done by brother-and-sister mating being contained in the same cage during the entire life. Concentration of the isotopes in water is composed of three levels. High level is 0.1 μ Ci of ^{90}Sr and 0.4 μ Ci of ^{137}Cs per ml; intermediate level is $1/10$ and low level is $1/100$ respectively. In the low group, total litter size slightly decreased and reproduction-span was delayed and lengthened. Intermediate and high group showed decrease of total litter size and shortening of reproduction-span except partial increase of litter size in first birth in intermediate group. (auth)

45901 BONE AND SOFT-TISSUE NEOPLASMS IN CATS EXPOSED TO RADIOSTRONTIUM. Ward, Jerrold M.; Wright, James F.; Nelson, Neal S.; (and others) (Twinbrook Research Lab., Rockville, Md. National Cancer Inst., Bethesda, Md.). J. Nat. Cancer Inst.; 48: No. 5, 1543-5(May 1972).

Four neoplasms of bone and soft tissues adjacent to bone developed in three cats from 274 to 609 days after initial oral administration of strontium-89. Neoplasms included a giant cell tumor, osteosarcoma, hemangiosarcoma, and fibrosarcoma. Cumulative dose to the skeleton of each cat varied from 1700 to 4850 rads. Feline leukemia virus was not detected in the neoplasms by a complement fixation test or ultrastructural examination. Comparative aspects of radionuclide carcinogenesis are discussed. (auth)

45902 DETERMINATION OF THE ^{131}I DOSE TO THE MOUSE THYROID. Walinder, G. (Foersvarets Forskningsanstalt, Stockholm). Acta Radiol., Ther., Phys., Biol.; 10: No. 6, 558-78(Dec 1971).

The radiation dose to the thyroid glands in fetal and adult mice after injections of ^{131}I was calculated by a mathematical model based on film measurements in excised glands and determinations of the thyroidal uptake and retention of the nuclide. The present measurements confirmed Loevinger's semitheoretic determinations of the β-dose to the adult mouse thyroid. (auth)

Plants

Refer also to abstract: 45529.

45903 MONITORING OF THE RADIOACTIVE CONTAMINATION OF WHEAT FLOUR. Coulon, R. (CEN, Fontenay-aux Roses, France). Union Agr.; No. 325, 53-5(Nov 1971). (In French).

A regional monitoring of the radioactive pollution of flours has been carried out in France since 1960. Samples from ten production regions were ground and studied. The results given the ^{137}Cs and ^{90}Sr concentration (in picocuries) per kg of flour, and per gram of K or per gram of Ca respectively. The values obtained for the 1968 and 1969 crops, and the mean values for the 1960–1969 period are presented. (France)

Nuclide Kinetics and Toxicology

Refer also to abstract: 45553.

Man

Refer also to abstract: 45538.

45904 (COO-3013-1) RADIATION HAZARDS IN ENVIRONMENTAL MEDICINE. Fabrikant, Jacob I. (Johns Hopkins Univ., Baltimore, Md. Dept. of Radiological Sciences). 5 Aug 1969. Contract AT(30-1)-3970. 12p. Dep. NTIS.

Radiation hazards to the health of human populations following the uptake and internal deposition of radioisotopes released to the atmosphere are considered from the standpoint of the contribution of radioisotopes released during the operation of nuclear power reactors. It is pointed out that during 1969 the atomic energy industry of the United States comprised a vast network of uranium mines, industrial plants, and laboratories that employed more than 100,000 people. While all these applications of nuclear energy have the capacity to contaminate the environment, with very few exceptions, the amounts of radioactive substances released so far have been so small that there has been no significant exposure of the public. Data are summarized on the uptake of ^{137}Cs, ^{131}I, and ^{90}Sr by man following release in fallout during nuclear weapons testing, and on the contribution of natural background radiation and diagnostic and therapeutic medical uses of radiation sources and radioisotopes to the radiation dose to man. It is concluded that, while the development of more nuclear reactors for power generation will involve more sources for potential radioactive contamination of man's environment, under normal operating conditions a nuclear reactor is a source of relatively insignificant amounts of environmental radioactivity and the safety devices built into the reactors and the stringent restrictions on the release of radioactive substances to the environment should ensure that the nuclear power industry does not present a threat to public health in the United States. (C.H.)

45905 (RD/B/N-2291) MULTI-COMPARTMENT MODEL FOR STUDYING THE DOSE-INTAKE RELATIONSHIP FOR RADIOACTIVE ISOTOPES. Clarke, R. H. (Central Electricity

Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Apr 1972. 38p. Dep. NTIS (U. S. Sales Only).

In identifying the organs at risk after the intake of radioactive material and in order to evaluate the doses in those organs, it is necessary to use a model of the human body in which the transfer of radioactive materials is amenable to mathematical analysis. Such a model was developed in which the various organs of the body were represented by single or multiple compartments, coupled to provide a simplified metabolism. The method of entry of radioactive material could be by inhalation, ingestion, through contaminated skin or a wound, using standard models for the respiratory and gastrointestinal tracts. The distribution of a parent nuclide and all its daughter products throughout the compartments was followed as a function of time by the solution of the set of first order differential equations that represent transport within the body. Either acute or chronic exposures were treated and facilities existed for varying metabolic parameters with time. The physical basis of the model is described together with the techniques used to solve the coupled equations to obtain retention and dose data. (auth)

45906 (TT-54002/4), pp 462-70) STATISTICAL DATA ON IODINE UPTAKE OF THE THYROID GLAND. PART II. ^{131}I UPTAKE AFTER 6 AND 24 HOURS ($T_{6/24}$). Doroszewski, Jan; Niewiadomski, Michal (Postgraduate Medical Education Centre, Warsaw. Inst. of Radiology, Warsaw). Translated from Przegl. Radiol. Med. Nukl.; 35: No. 4, (1971).

When interpreting the results of iodine uptake tests, not only the general level of ^{131}I uptake by the thyroid, but also its dynamics is significant. Accurate determination of the changes in ^{131}I content of the thyroid would require repeated measurements of radioactivity of the gland at intervals after administration of the diagnostic dose of the indicator, which would not be feasible in ambulatory practice. Some information about ^{131}I content of the thyroid can be obtained, however, by making only two measurements at different times. A widely used method for studying iodine uptake on the basis of two measurements consists in measuring ^{131}I activity in the thyroid gland 6 and 24 hrs after administration of the diagnostic dose $T_{6/24}$. (auth)

45907 HUMAN FAECAL ^{226}Ra EXCRETION SHORTLY AFTER A $RaSO_4$ DUST CONTAMINATION, WITH ALGINATE TREATMENT. Vander Borght, O.; Colard, J.; Boulenger, R. (Centre d'Etude de l'Energie Nucleaire, Mol, Belgium). Health Phys.; 23: No. 2, 240-3(Aug 1972).

Data are presented on the excretion of ^{226}Ra after oral uptake by a 50 yr old healthy woman following the breakage of a 17 yr old therapeutic ampoule containing 50 mCi $^{226}RaSO_4$. A regular diet of alginated bread, resulting in an intake of 15g alginate per day, was eaten until the 20th day after contamination. The fecal ^{226}Ra contents per day for 160 days are tabulated and compared with previous data presented by Marinelli (1958). Measurements made in a whole-body counter are given. Much data on the case were lost and the reasons are given. On day 12 a residual body burden of 1.3×10^4 pCi ^{226}Ra was measured representing about 10% retention. (UK)

45908 LONG-TERM STUDY OF THE URINARY ^{90}Sr AND CALCIUM IN CHILDREN. Czosnowska, W. (Inst. of Nuclear Research, Warsaw); Pietrzak-Flis, Z.; Grabowski, D. Health Phys.; 23: No. 2, 215-21(Aug 1972).

The intake and the excretion of ^{90}Sr and Ca in the urine of seven children, aged 4 to 7 yr, were observed during 28 consecutive months. The average intake was 12.4 pCi/day of ^{90}Sr and 539 mg/day of Ca. The average urinary ^{90}Sr was 0.71 pCi/day, while urinary Ca amounted to 33.0 mg/day. The average urine-diet observed ratio was 1.33. It was concluded that the urine-diet observed ratio and urinary Ca was connected with the same relationship for each subject studied and that the equation obtained for children could be an extension of the relationship obtained for adult Polish people. (TSS)

45909 ^{22}Na IN THE FOOD-CHAIN: LICHEN-REINDEER-MAN. Soeren Mattsson, L. J. (Univ. of Lund, Sweden). Health Phys.; 23: No. 2, 223-30(Aug 1972).

The ^{22}Na content of samples of lichen, reindeer-blood, -flesh and -bone collected between 1961 and 1969 in the area of Funäsdalen in central Sweden (62.5°N, 12.5°E) was measured by means of a sum-coincidence γ-spectrometer. After the thermonuclear detonations in 1961 and 1962, the radioactive concentration of ^{22}Na in reindeer-flesh rose rapidly from about 1 to 10 pCi per kg to a maximum value of 200 pCi per kg wet weight in late 1964. Early in 1969 the same value had decreased to 25 pCi per kg wet weight. The radioactive concentration of ^{22}Na in reindeer-bone reached a maximum of 600 pCi per kg wet weight in mid-1965. The biological half-time of sodium incorporated in reindeer-bone was estimated to be about 0.5 yr. Analyses of γ-spectra from the annually performed whole-body measurements on Lapps give a ^{22}Na-body burden of less than 2 nCi at the time of assumed maximum. The presence of ^{22}Na in the food-chain: lichen-reindeer-man has given a small contribution to the absorbed dose in man in comparison to many other bomb-produced and naturally occurring radionuclides. (auth)

Animals

Refer also to abstracts: 45545 and 45902.

45910 (CONF-720505-2) INCREASED EFFECTIVE HALF-LIFE OF INTRATRACHEAL ADMINISTERED $^{51}Cr_2O_3$ BY RESPIRATORY INFECTION. Creasia, D. A.; Nettesheim, P.; Hammons, Anna S. (Oak Ridge National Lab., Tenn.). 1970. 22p. Dep. NTIS.

From twelfth Hanford biology symposium on radionuclide carcinogenesis; Richland, WA. (11 May 1972).

The effect of lower respiratory tract infections on the clearance of radioactive materials from the lungs was studied. Respiratory infections were produced in pathogen-free mice by the intranasal inoculation of influenza virus. Chromium-51 was administered as chromium oxide by intratracheal injection and the effective half-life in the lungs was determined. It was found that the $T^1/_2$ was increased in infected mice 1.3 to 2.1 times over that in uninfected mice when the $^{51}Cr_2O_3$ was administered prior to the acute stages of infection. When $^{51}Cr_2O_3$ was administered after the acute infectious episode, the $T^1/_2$ values were lower but still represented an increase over those in uninfected mice. It is pointed out that the degree of retention was determined, not by the infection per se, but rather by the extent and persistence of inflammatory and scarring processes. Other types of respiratory infections and injuries induced by noninfectious agents may have similar effects. (E.R.B.)

45911 (COO-3013-25) RADIOBIOLOGY AND THE PUBLIC HEALTH. Fabrikant, Jacob I. (Connecticut Univ., Farmington. Dept. of Radiology). [1968]. Contract AT(30-1)-4244. 48p. Dep. NTIS.

Results are reviewed from a number of studies on the effects of radiation delivered at low doses and low dose rates on cells, tissues, and organisms. Emphasis is placed on the effects of chronic internal irradiation at the cellular and molecular level and repair mechanisms that ameliorate the effects of radiation injuries. It is pointed out that the radiosensitivity of mammalian cells varies enormously depending on species, organ, mitotic activity, physiological state, and environmental factors, as well as radiological variables such as dose, dose rate, and LET. It is emphasized that direct quantitative extrapolation of results of radiobiological studies on laboratory animals to man is not possible. Experimental evidence indicates that exposure to any radiation at any dose and dose rate involves some risk of deleterious effects. However, levels of natural radioactivity existed during the early evolution of man that were of higher intensity than levels existing at present. The control of environmental levels of radioactivity has become a sociological and political problem and unless man wishes to dispense with medical and industrial activities that involve low dose exposure to ionizing radiations he must evaluate the risks and limit the radiation exposure to a dose level at which the risk is acceptable to the individual and to society. (C.H.)

45912 (ORO-3728-5) MUTAGENIC EFFECT OF TRANSMUTATION FROM RADIONUCLIDES INCORPORATED INTO DNA OF DROSOPHILA MELANOGASTER. Progress Report, September 1970-May 1972. Lee, William R. (Louisiana State Univ., Baton Rouge. Dept. of Zoology and Physiology). Contract AT(40-1)-3728. 8p. Dep. NTIS.

Experiments were conducted to determine the genetic effects of transmutation of ^{33}P and this was compared with previous results of genetic effects of transmutation of ^{32}P and ^{14}C. It was found that approximately 50% more ^{33}P can be fed to Drosophila than ^{32}P without causing excessive sterility. In experiments with ^{33}P an increase in the mutation rate was observed in the non-stored as well as stored spermatozoa due to beta radiation during the labeling process. This elevation to about a 4% sex-linked recessive lethal rate observed in the F_2 at the beginning of storage makes the 0.13% spontaneous rate during storage insignificant. Therefore, with neither a significant increase in mutation due to beta radiation nor spontaneous mutations during storage, any increase in mutations observed during storage is attributed to transmutation of the incorporated radionuclide. The negative results obtained for lethals observed in the F_3 are in contrast to previous results with ^{32}P. The significance of this is that the mutational effect observed in earlier experiments with ^{32}P is due to the recoil of the ^{32}S nuclide and not due to either change in atomic number or excitation; these two events should be the

same for both ^{33}P and ^{32}P. A series of doubly labeled experiments using ^{3}H and ^{33}P was conducted to determine what percentage of ^{33}P in the cell was located in the DNA molecule. (H.L.W.)

45913 (RLO-2227-T-8-3) RADIONUCLIDE CYCLING IN NATURAL POPULATIONS OF AMPHIBIANS. Annual Progress Report, June 16, 1971-June 15, 1972. Willis, David L. (Oregon State Univ., Corvallis. Dept. of General Science). 1972. Contract AT(45-1)-2227. 17p. Dep. NTIS.

Progress is reported on radionuclide metabolism studies in the newt (Taricha granulosa). Whole-body retention and tissue distribution of ^{51}Cr, ^{54}Mn, ^{59}Fe, and ^{181}W were investigated. Results are presented in the form of graphs and the radioecological significance is discussed. Studies were also conducted on effects of chronic exposure to ^{134}Cs on the developing frog (Rana pretiosa). (H.L.W.)

45914 (TID-25954, pp 58-64) PERSISTENCE OF RADIONUCLIDES IN SOIL, PLANTS, AND SMALL MAMMALS IN FALLOUT CONTAMINATED AREAS. 1972.

In Radioecology and ecophysiology of desert plants at the Nevada Test Site.

The persistence of radionuclides in soil, plants, and small mammals was investigated in 1966 in areas that had been contaminated with fallout from above-ground nuclear detonations at the Nevada Test Site during the period 1952-1959. Study sites were established at various locations out to about 225 km from ground zero. Emphasis was placed upon the movement of ^{90}Sr and ^{137}Cs from abiotic to biotic components. Several neutron activation products were also studied in fallout areas located within 5 km of recent nuclear excavation tests. Radionuclides continued to be taken up through plant roots in small amounts as time progressed, and some continued to be deposited on foliage as resuspended dust particles. The inhalation route of entry became less important with passing time, whereas ingestion continued to be the most important route through which radionuclides entered small mammals living in old fallout areas. Long lived ^{90}Sr accumulated primarily in bone tissue while ^{137}Cs accumulated in muscle and soft tissue. Most of the neutron activation products are short-lived, but among those found in animal tissues were isotopes of cobalt, manganese, and tungsten. Findings indicate that ^{90}Sr and ^{137}Cs will continue to move in small amounts from abiotic to biotic components in fallout-contaminated areas with passing time. (auth)

45915 (UR-3490-115) EXPERIMENTAL INHALATION OF METALLIC SILVER. Phalen, Robert F.; Morrow, Paul E. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1971. 33p. Dep. NTIS.

Dogs were tracheally intubated and exposed to airborne particles produced by exploding ^{110m}Ag wires. The particles were agglomerates of spherical primaries and had activity median aerodynamic diameters near 0.5 microns. The deposition fraction in the respiratory tract was 0.17 ± 0.05; absolute deposition averaged about 1 $\mu g/kg$ of body weight. Translocation and clearance of the deposited material was followed by external gamma-ray detectors collimated to measure activity at several sites in each animal. Clearance data were analyzed into exponential components. The lung had biological clearance half-lives of 1.7, 8.4, and 40 days accounting respectively for about 59%, 39%, and 2% of the total amount deposited. Corresponding values for the liver were 9 days (97%) and 40 days (3%). Excretion was predominantly fecal, the major portion of which was believed to have been secreted into the bile. Sacrifice measurements showed that the liver was a major site for the deposition of silver. Lung, brain, and muscle also contained relatively large accumulations. Results showed that existing ICRP biological values for evaluating the hazards from radioactive silver are unreliable for inhalation. For example, considerably more silver (perhaps 90% of that initially deposited in the lungs) was absorbed into the body for general internal distribution, than would be calculated from the ICRP figures. (auth)

45916 (UR-3490-159) RETENTION OF ^{210}Pb IN BEAGLE DOGS. Hursh, John B. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1971. 20p. Dep. NTIS.

A study involving four beagle dogs injected intravenously with ^{210}Pb and observed for two years has yielded data indicating a marked similarity between the retention of lead and the retention of strontium by the beagle dog. (auth)

45917 METABOLISM OF MONOMERIC AND POLYMERIC PLUTONIUM IN THE RABBIT. COMPARISON WITH THE MOUSE. Rosenthal, M. W.; Lindenbaum, A.; Russel, J. J.; Moretti, E.; Chladek, D. (Argonne National Lab., Ill.). Health Phys.; 23: No. 2, 231-8(Aug 1972).

Young adult female Dutch Belted rabbits were given a single intravenous injection of polymeric ^{239}Pu-nitrate (15% ultrafilterable) or of monomeric ^{239}Pu-citrate (90% ultrafilterable) and killed at 3 days. The plutonium content of the intact femur (bone plus marrow) was higher after the polymeric form. Physical removal of marrow from bone in the tibia showed the plutonium content of the bone to be slightly lower and of the marrow to be 17-fold higher after polymeric than after monomeric plutonium. Polymeric plutonium was also more concentrated in spleen, ovaries, intestines (with contents), skeletal muscle, and urine but less concentrated in liver. About the same levels of the two forms of plutonium were found in blood, bile, and lung. For the first 30 min after injection, the polymeric plutonium was cleared from the circulation more rapidly than the monomeric. After about 60 min, the two forms were cleared at generally comparable, decreasing rates. Polymeric plutonium was as much as 10 to 30 times more concentrated in predominantly red (erythropoietic) marrow than in fatty marrow. Monomeric plutonium was 1.3 to 2.8 times more concentrated in the red marrow. Mice injected with the same plutonium solutions as the rabbits showed, in comparison, a higher percent of the injected monomeric plutonium in the femurs and a lower percent in the liver; they showed a higher uptake of polymeric plutonium in the marrow, and a higher uptake of both forms in the spleen and lungs than did the rabbits. (auth)

45918 EFFECT OF ALUMINUM PHOSPHATE GEL ON WHOLE-BODY RETENTION OF SIMULTANEOUSLY ADMINISTERED ^{226}Ra, ^{85}Sr, AND ^{47}Ca IN MICE. Keslev, D.; Van Puymbroeck, S.; Van der Borght, O. (SCK/CEN, Mol, Belgium). Experientia; 28: No. 5, 524-5(15 May 1972).

A mixture of ^{226}Ra, ^{85}Sr, and ^{47}Ca was administered by gastric tube to mice and each animal received aluminum phosphate gel by gastric tube; control animals received agar gel. A table is presented to show total body retention of the administered dose four days after gastric intubation. It was found that aluminum phosphate gel, administered simultaneously with the isotopes, reduced the ^{226}Ra burden by a factor of 800, the ^{85}Sr burden by a factor of 10, and the ^{47}Ca burden by a factor of 3. (H.L.W.)

45919 VOPROSY PRODUKTSIONNOI, SANITARNOI I TEKHNICHESKOI GIDROBIOLOGII YUZHNYKH MOREI. (Problems of Production, Sanitation, and Technical Hydrobiology of the Southern Seas). Zorina, T. A. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1971). 196p.

This book is a collection of 19 papers by various authors on primary productivity in biological systems, and the hydrologic and hydrochemical conditions which prevail in the southern seas (Black Sea, Red Sea, and Mediterranean Sea). Two papers are concerned with the effects of ^{137}Cs and ^{90}Sr on the development of embryos of fish and sea urchins, and the cytogenetic effects resulting from the uptake of artificial radionuclides (^{137}Co, ^{90}Sr, ^{90}Y, ^{91}Y, and ^{14}C) by marine organisms. (K.S.W.)

45920 MEASUREMENT OF ^{226}Ra IN MICE. Lenger, V. (Inst. of Radiation Hygiene, Prague). Acta Radiol., Ther., Phys., Biol.; 10: No. 5, 488-96(Oct 1971).

Low Compton scattering affords means of direct measurement of the ^{226}Ra 187 keV line, the quantitative evaluation being based on the phantom calibration procedure. The nonequilibrium state is an advantage. The retention curves of ^{226}Ra in mice during a period of up to 352 days are presented and the kinetics of daughter products, especially of ^{222}Rn, proved. (auth)

45921 DIFFUSION DEPOSITION OF SMALL-SIZED PARTICLES IN THE BRONCHIAL TREE. Martin, D.; Jacobi, W. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Health Phys.; 23: No. 1, 23-9(Jul 1972).

The deposition pattern of radioactive aerosols (AMI) = 0.2-0.4 μm) was studied in a plastic model of the upper bronchial tree, whose geometry corresponded with a dichotomous lung model. The deposition probabilities w in the different bronchial regions for inspiration and expiration were measured as a function of air flow rate v in the range of 0.1 to 50 l/min. Radioautographs were also prepared to study the fine structure of the deposition pattern. The measured w-values can be approximated by the relation $w = k \cdot v^{-n}$ ($n > 0$), where k is a characteristic factor for each generation and nearly equal for inspiration and expiration. The slope-coefficient n amounts to 0.65 ± 0.07 for all bronchial generations. The results indicate that deposition due to turbulent diffusion plays an important role in the trachea and larger bronchi. With increasing depth in the bronchial tree, however, the measured w-values approach the theoretical values, calculated with the theory of Gormley and Kennedy (Proc. Proj. Irish Acad. 52A: 163 (1949)), for diffusion in a laminar air stream. (auth)

45922 EFFECT OF MASS ON PROMETHIUM RETENTION AND REMOVAL FROM THE RAT. Smith, V. H. (Battelle-Northwest, Richland, Wash.). Contract AT(45-1)-1830. Health Phys.; 23: No. 1, 31-9(Jul 1972).

Seven days after intravenous administration to rats of 3.32×10^{-4} to 5.36×10^{3} mmole of isotopic or carrier-diluted $PmCl_3$ the fraction of injected monomeric promethium retained in the skeleton was greatest at the lowest mass administered. Generally no mass effect was observed in kidney, liver or spleen at the monomeric mass levels administered. The effectiveness of 0.3 mmole diethylenetriaminepentaacetic acid (DTPA) in decreasing the fraction of injected promethium retained in the skeleton following prompt (1 hr) or delayed (48 hr) treatment was less for the lowest mass injected than for other monomeric masses. In the soft tissues a relatively constant fraction of the control rats' promethium tissue burden was removed by DTPA treatment at all monomeric mass levels. At the highest mass level particulate formation typically altered the distribution as well as effectiveness of DTPA treatments. While the amount of promethium removed from most of the examined tissues by DTPA treatments at each monomeric level was an almost constant fraction of that retained in the control tissues, the moles of promethium removed increased with injected mass as the molar ratio of DTPA : Pm varied from 10^{9} to 10^{5}. In extending the results of animal experiments and tracer-level human experiments as predictors of radionuclide retention and of the efficacy of removal procedures in accidental human exposure situations, due regard should be given to the possible effect of mass as well as to the physical state of the incorporated radionuclide. (auth)

Plants

Refer also to abstracts: 45550 and 45755.

45923 (TID-25954, pp 69-72) ^{90}Sr UPTAKE BY DESERT VEGETATION. 1972.

In Radioecology and ecophysiology of desert plants at the Nevada Test Site.

The levels of ^{90}Sr uptake varied among different species of desert vegetation. A species of range grass, Oryzopsis hymenoides, had the lowest ^{90}Sr content of the species investigated and, perhaps significantly, the lowest specific activity of ^{90}Sr per stable strontium of all the species. Highest uptake of ^{90}Sr occurred in Atriplex confertifolia, Atriplex hymenelytra, and Lycium andersonii. Nearly the same levels of ^{90}Sr concentrated in leaf and stem tissues of Artemisia tridentata, Astragalus lentiginosus, and Larrea divaricata. In Atriplex confertifolia and Atriplex hymenelytra the ^{90}Sr was concentrated highest in stem tissue. The other species studied concentrated as much as three times more ^{90}Sr in leaf tissues as in stems. A similar distribution pattern occurred for the stable strontium levels in leaf and stem tissues of these desert plant species. A higher correlation coefficient was obtained for $^{90}Sr \times$ strontium than for $^{90}Sr \times$ other cations or sum of cations. The leaf-stem ratio for the ^{90}Sr was more correlated with the leaf-stem ratio for stable strontium than with other cations. There was a positive correlation between specific activity of ^{90}Sr and the cation sum of leaves. (auth)

45924 PLUTONIUM AND POLONIUM INSIDE GIANT BROWN ALGAE. Wong, K. M.; Hodge, V. F.; Folsom, T. R. (Univ. of California, San Diego). Nature (London); 237: No. 5356, 460-2 (23 Jun 1972).

Certain marine algae accumulate Pu so effectively that they might be used to detect small concentration changes of the element in seawater, where direct determination would be difficult. In a survey made in 1971, near a coastal power reactor after reported accidental burnup of fuel rods carrying 17,000 Ci of ^{238}Pu, Pu and other nuclides were compared in various types of algae, and large accumulations were found in several species; concentrations, however, ranged widely within species and suggested a correlation between activity and surface area. Attention was turned to comparing different tissues of one giant brown algae, Pelagophycus porra. Samples dissected for Pu analysis by α-spectrometry were also analyzed for ^{210}Po; it was hoped that the distribution of ^{210}Po might serve as a model for predicting distributions of the less easily analyzed ^{239}Pu and certain other heavy metals. Concentrations of ^{210}Po varied significantly between different parts of the plant, and even between different sections of the same part, but were always much higher in the outermost layers; this also applied to ^{239}Pu concentrations, but to a lesser degree. Another finding was that for comparison of two different environments it is not sufficient merely to sample a given species, but identical sample tissue must be compared. (UK)

45925 EFFECT OF SOIL CONDITIONS AND POTASSIUM SUPPLY ON THE UPTAKE AND DISTRIBUTION OF ^{86}Rb IN THE ORGANS OF CORN PLANTS. Ivanov, S. N.; Nikitenko, N. F. Dokl. Akad. Nauk BSSR; 16: No. 2, 141-3(Feb 1972). (In Russian).

The uptake of ^{86}Rb by the entire corn plant and by its tissues in less fertile soils with low exchange potassium content proceeds at a higher rate than in soils which are well-fertilized and containing considerable exchange potassium. In well-limed soils ^{86}Rb uptake by corn is 1.5 to 2 times lower per unit weight than in un-limed. In the stalking phase the ^{86}Rb content in the stems is 1.5 to 2 times greater than in the leaves. With the appearance of the reproductive organs the ^{86}Rb content per unit weight of biomass is distributed as follows: highest in the panicle, then the leaves, and least in the stems. (tr-auth)

45926 STATISTICS OF RADIOISOTOPE ACCUMULATION IN HYDROBIONTS. Piskunov, L. I. (Sverdlovsk Regional Health-Epidemiological Station). Gidrobiol. Zh.; 6: No. 5, 70-2(1970). (In Russian).

Hydrobionts, especially fresh-water plants, are distinguished by an asymmetric exchange of elements which leads to an accumulation of certain elements until a steady-state condition is reached. A statistical study was made of this type of accumulation in hydrobionts, and certain regularities in the process were found. The correlating connection in the complex pattern of microelement exchange should be regarded as only one of the possible mechanisms for radioisotope migration within the biological chain. (K.S.W.)

New Tracer Techniques

45927 (TT-54002/4, pp 471-4) METHOD FOR LABELING HUMAN ALBUMIN WITH ^{99m}Tc. Sadowska, Barbara; Zelenay, Krystyna (Inst. of Nuclear Research, Swierk, Poland). Translated from Przegl. Radiol. Med. Nukl.; 35: No. 4, (1971).

A simple method for labeling human albumin with technetium-99^{m}, which can be easily adapted for clinical purposes, is described. The yield of the radiochemical method, after purification, was 60%. Clinical investigations showed a complete usefulness of the obtained preparation and controls of radiochemical purity proved that the content of technetium-^{99m} not bound to albumin is much below 5%. (auth)

45928 SIMULTANEOUS RADIOIMMUNOASSAY OF PLASMA TESTOSTERONE AND DIHYDROTESTOSTERONE. Coyotupa, Juan; Parlow, Albert F.; Abraham, Guy E. (Univ. of California, Torrance). Anal. Lett.; 5: No. 6, 329-40(1972).

A method is described for the simultaneous radioimmunoassay of plasma testosterone (T) and 5α-dihydrotestosterone (DHT), using as binding reagent a highly specific antiserum which reacted significantly with T and DHT. Utilizing a one step celite microcolumn to separate T from DHT, we have measured these two androgens accurately in small aliquots of plasma from both male and female subjects. Plasma concentrations of T and DHT expressed as mean ±S.D. in ng/ml were respectively: in male subjects: normal adult: 4.9 ± 1.6 (T) and 1.3 ± 0.8 (DHT); hypogonadal: 0.24 ± 0.08 (T) and 0.20 ± 0.10 (DHT); prepubertal: 0.14 ± 0.02 (T) and 0.05 ± 0.02 (DHT); in female subjects: normally menstruating, irrespective of time of cycle: 0.22 ± 0.07 (T) and 0.34 ± 0.17 (DHT); postmenopausal: 0.29 ± 0.08 (T) and 0.15 ± 0.07 (DHT); ovariectomized: 0.24 ± 0.06 (T) and 0.09 ± 0.01 (DHT). When plasma levels of T and DHT were measured during a complete menstrual cycle, the levels of these steroids were found to be higher during the luteal than during the follicular phase. The ratio of plasma T : DHT concentrations was five times higher in normal adult male (3.1) than in menstruating female subjects (0.6). (auth)

45929 BLEOMYCIN LABELED WITH ^{57}Co. APPLICATION TO THE DIAGNOSIS OF MALIGNANT TUMORS AND THEIR GROWTH. Nouel, J. P. (Centre Henri Becquerel, Rouen); Renault, H.; Robert, J.; Wicart, L. Nouv. Presse Med.; No. 2, 95-8(8 Jan 1972). (In French).

Intravenous injection of ^{57}Co labeled bleomycin enables primitive cancers to be detected and unsuspected metastasis to be revealed. This method is superior to existing techniques. (France)

MATERIALS

Ceramics and Cermets

Refer also to abstracts: 45311, 45407–45417, 45452, 45973, 45979, 45992, 45997, 46002, 46013, 46039, 46074, 47244, 47249, and 47255.

45930 (HEDL-TME-72-81) EFFECTS OF PORE STRUCTURE ON THE MELTING HEAT RATING OF OXIDE FUELS. Lawrence, L. A.; Gibby, R. L. (Hanford Engineering Development Lab., Richland, Wash.). May 1972. Contract AT(45-1)-2170. 41p. Dep. NTIS.

Mixed uranium–plutonium oxide fuels prepared by different fabrication techniques can have significantly different thermal properties. These differences, which stem from differences in pore shape and distribution characteristics resulting from the fabrication process, were investigated using thermal diffusivity techniques and in-reactor experiments. Fuel characterized by large amounts of linear porosity was found to have a thermal conductivity 30 to 40% lower than fuel of equivalent density with uniformly distributed fine spherical porosity and large isometric pores. Results of the irradiations confirmed a lower melting heat rating for fuel characterized by large amounts of linear porosity. Results of the irradiations were compared to temperature profile predictions based on the laboratory thermal diffusivity data. Reasonable agreement is obtained if expected effects of oxygen redistribution down the thermal gradient in the fuel are considered. (auth)

45931 (KAPL-3164) FABRICATION OF ALUMINUM OXIDE FILMS. Hance, A. B.; Hanrahan, L. R. (Knolls Atomic Power Lab., Schenectady, N. Y.). 27 Jul 1966. Contract W-31-109-eng-52. 8p. Dep. NTIS.

A simple low-cost procedure for the forming of Al_2O_3 films from common household aluminum foil is described. A method for accurately controlling the film thickness is described for self-supporting films of Al_2O_3 ranging from several hundred to 1000 Å thick. The method can be used for anodizing a smooth aluminum surface to form an Al_2O_3 surface layer of uniform thickness ranging from ~100 Å to 1000 Å. (auth)

45932 (LBL-450) HIGH-TEMPERATURE SPECTROSCOPY AND THERMODYNAMICS OF TITANIUM OXIDE AND VANADIUM OXIDE. Chang, Shih-Ger (California Univ., Berkeley. Lawrence Berkeley Lab.). Mar 1972. Contract W-7405-eng-48. 143p. Dep. NTIS.

Thesis.

Absolute emission measurements of (0,0) band of TiO α-system and VO green system were made on photographic plates. The TiO vapors were in equilibrium with $TiO_{1.6}$ liquid phase at 2140 to 2400°K and VO vapors were in equilibrium with VO solid and liquid phases at 2000 to 2150°K in an electric furnace. The integrated radiance of the band was determined by matching the observed profiles with the profiles determined theoretically. The radiance measurements and equilibrium partial vapor pressures of TiO and VO from mass spectroscopy and thermodynamic data yield: $f_{em} = 0.144$ for TiO (0,0) band $C^3\Delta$-$X^3\Delta$ transition, and $f_{em} = 0.0058$ for VO (0,0) band $C^4\Sigma^-$-$X^4\Sigma^-$ transition. These correspond to an upper bound of radiative lifetime of 2.82×10^{-8} sec for $v' = 0$ $C^3\Delta$ state of TiO and 8.65×10^{-7} sec for $v' = 0$ $C^4\Sigma^-$ state of VO. (auth)

45933 (N-72-15609) SHOCK AND VIBRATION TESTS OF URANIUM MONONITRIDE FUEL PELLETS FOR A SPACE-POWER NUCLEAR REACTOR. Adams, Donald W. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Feb 1972. 31p. (NASA-TM-X-2493; E-6584). NTIS.

Shock and vibration tests were conducted on cylindrically shaped, depleted, uranium mononitride (UN) fuel pellets. The structural capabilities of the pellets were determined under exposure to shock and vibration loading which a nuclear reactor may encounter during launching into space. Various combinations of diametral and axial clearances between the pellets and their enclosing structures were tested. The results of these tests indicate that for present fabrication of UN pellets, a diametral clearance of 0.254 millimeter and an axial clearance of 0.025 millimeter are tolerable when subjected to launch-induced loads. (auth) (STAR)

45934 (N-72-18585) DEVELOPMENT OF DISPERSION-STRENGTHENED Ni–Cr–ThO_2 ALLOYS FOR THE SPACE-SHUTTLE THERMAL PROTECTION SYSTEM. Blankenship, Charles P.; Saunders, Neal T. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). 1972. 33p. (CONF-720301-6; NASA-TM-X-68024; E-6830). NTIS.

From Spring conference of the American Society for Nondestructive Testing; Los Angeles, Calif. (13 Mar 1972).

Manufacturing processes were developed for TD-NiCr providing small sheet (45 × 90 cm), and larger sheet (60 × 150 cm) and foil. The alternate alloy, DS-NiCr, was produced by pack-chromizing Ni-ThO_2 sheet. Formability criteria are being established for basic sheet forming processes, which are brake forming, corrugation forming, joggling, dimpling, and beading. Resistance spot welding (fusion and solid state), resistance seam welding, solid state diffusion welding, and brazing are included in the joining programs. Major emphasis is centered on an Al-modified Ni–Cr–ThO_2 alloy development. These alloys, containing 3 to 5% Al, form the protective Al_2O_3 scale. This enhances oxidation resistance under reentry conditions. Both TD-NiCrAl and DS-NiCrAl alloys are included. A tentative composition of Ni–16Cr–3.5Al–$2ThO_2$ was selected based on oxidation resistance and fabricability. (auth) (STAR)

45935 (SC-RR-710884) OXIDATION AND ETCHING OF 80 PERCENT Si–20 PERCENT Ge. Fuller, C. T.; Loescher, D. H. (Sandia Labs., Albuquerque, N. Mex.). Dec 1971. 27p. Dep. NTIS.

Ellipsometry has been used to study the oxidation and chemical etching of 80% Si–20% Ge alloy. Oxidations were performed at 25, 50, and 800°C in air and at 85°C in water. The rate of oxidation at 25 and 50°C is low and is similar to that of Si. The rate of oxidation is rapid enough in 85°C water that the use of lower temperatures for washing samples is indicated. At 800°C the oxidation behavior of the alloy is like that of Si. For oxidation at 800°C and for times longer than about 30 minutes, the indices of refraction of the alloy surface and the oxide are almost identical to those of silicon. Estimates of oxide thickness on the alloy can be obtained from published data for Si. The data for oxidation of the alloy suggest that the Ge concentration at the alloy surface and in the oxide is depleted during oxidation but the mechanism for depletion is not understood. It was found that chemical etching is best accomplished with solutions of HF and HNO_3 containing at least 70% HNO_3. (auth)

45936 (UCRL-Trans-10632) CRYSTALLIZATION OF BORON-RICH BERYLLIUM BORIDES AND ALUMINUM BERYLLIUM BORIDES FROM ALUMINUM MELTS. Becher, H. J. Translated for Univ. of California Lawrence Livermore Lab., Livemore, from Acta Crystallogr.; 17: No. 5 617(1964). 4p. Dep. NTIS.

In experiments with the system Be/Al/B, the compound Be_2B was finely powdered and fused with ten times its weight of Al for two hours in a sintered corundum crucible under argon at 1450°C. After treatment of the cooled regulus with HCl, a crystalline, dark residue consisting mainly of octahedral and icosahedral crystals having an average size of 0.05 mm remained. Analysis of the crystals gave the formula BeB_2. In other experiments, the B-rich compound BeB_{12} was fused with 15 times its weight of Al. Together with impurities, the product was found to contain many reddish crystals, some being octahedral and other hexagonal leaflets. The identity periods of the αAlB_{12} lattice were found from rotating-crystal photographs. From density determinations, it was found that on crystallization from the Al melt, BeB_{12} and Al formed solid solutions having the composition $(BeB_6)_2AlB_{12}$, corresponding to a reaction $2BeB_{12} + Al \rightarrow (BeB_6)_2$-$AlB_{12}$. It was noted that despite the large excess of Al, Be is not displaced from its union with B. (P.C.H.)

45937 THERMODYNAMIC STUDY OF ORDER–DISORDER TRANSITIONS IN VANADIUM CARBIDE. Emmons, George Herbert. Urbana, Ill.; Univ. of Illinois (1972). 175p. University Microfilms Order No. 72-19,824.

Thesis.

Differential thermal analysis was used to measure the thermodynamic properties of V_6C_5 and V_8C_7 at the order-disorder transitions of their respective carbon sublattices. The critical temperatures and enthalpy increases due to disordering were determined to be: 1250°C ± 2°C and 6.65 cal/gm ± 2.90 cal/gm for V_6C_5 and 1152°C ± 2°C and 7.04 cal/gm ± 3.07 cal/gm for V_8C_7. The Bragg–Williams approximation was adapted to the carbon sublattice of V_6C_5 and was used to estimate properties of the order-disorder transition. An enthalpy increase due to disordering of 8.75 cal/gm was predicted using the critical temperature determined by DTA and the B-W approximation. The temperature range over which disordering is observable in V_6C_5 powders using DTA is smaller than predicted by B-W but in good agreement with the temperature range over which the effects of disordering are observable through resistivity changes in single crystal samples. The additional enthalpy increase of V_6C_5 below T_c is 33% of the total additional en-

thalpy increase of the transition. The latent heat of the transition $V_6C_5 + VC_{0.83}$ is 3.3 ± 1.0 cal/gm. The behavior of the isobaric specific heat below the critical temperature is consistent with a critical behavior described by $C_V = A \ln|\epsilon| + B$. Compositions of the V-C system between the compounds V_6C_5 and V_8C_7 (VC_x, $0.833 < x < 0.875$) undergo transitions at the critical temperatures of V_6C_5 and V_8C_7. The ratio of the enthalpies of these two transitions is in good agreement with a ratio predicted from the carbon-to-metal ratio of these compositions, x, assuming that they are mixtures of the ordered compounds V_6C_5 and V_8C_7. (Diss. Abstr. Int., B)

45938 TRANSPORT PROPERTIES OF THORIA AND THORIA-BASED SOLID SOLUTIONS. Etsell, T. H. (Max-Planck-Institut fuer Chemie, Mainz). Z. Naturforsch.; 27a: No. 7, 1138-49(Jul 1972).

The methods for obtaining transport numbers in oxides are described and associated experimental difficulties are discussed. Their reliability is assessed and used in conjunction with related data to offer a consistent picture for thoria and thoria-based solutions between 500 and 1600°C. Both are ionic conductors within certain ranges of oxygen pressure. It is concluded that, for ThO_2, and, for $ThO_2-Y_2O_3$ solutions (10 to 20 mole % $YO_{1.5}$), $\log P_{\oplus} = -4.5$, $\log P_{\ominus} = -60.5 \times 10^3/T + 23.3$, and $\log P_{\oplus} = 1.8$, $\log P_{\ominus} \sim -57.9 \times 10^3/T + 12.4$ where $P_{\oplus}$ and $P_{\ominus}$, respectively, are the oxygen pressures (atm) where the ionic and p-type and the ionic and n-type conductivities are equal. Ionic conductivity and charge carrier mobilities in thoria are briefly considered. (auth)

45939 FISSION RECOIL FROM SURFACE OF NUCLEAR FUELS BY IRRADIATION. Bloem, P. J. C.; Schurink, F. Ned. Tijdschr. Natuurk.; 37: 448-52(11 Nov 1971). (In Dutch).

When reactor fuel is irradiated by neutrons, fission fragments with high energies are released and cause, by leaving the oxide surface, a damage of the lattice. The extent of this damage in ThO_2/UO_2 fuel, fabricated as spheres with a diameter of 5 μ by the KEMA sol-gel process, was investigated. Irradiation took place in water at different temperatures, in air, in organic liquids, and in solutions. Radiation damage was measured by the amount of material which was released from the surface and which can be easily etched off from the disturbed surface. It was found that oxygen had a great influence on the damage of the oxide lattice, while KI additions to the water greatly reduced the damage by eliminating the OH-radicals. A few possible damaging mechanisms of UO_2/ThO_2 upon irradiation in water are discussed. (Netherlands)

45940 METHOD FOR THE MANUFACTURE OF FISSILE OXIDES AND THE APPARATUS DEVELOPED. Bazin, Roger; Delpech, Andre (to Commissariat a l'Energie Atomique). French Patent 2,088,170. 7 Jan 1972. Filed 25 May 1970. (In French).

A method for directly preparing uranium oxide suitable for sintering and subsequent use as nuclear fuels, from uranyl nitrate solutions, is described. A uranyl nitrate/formic acid solution is atomized in an enclosure maintained between 150 and 300°C, the product obtained is then transformed into oxide by calcination. Formic acid is added to a uranyl nitrate solution at a concentration equal to at least 0.4 ml/gram of uranium. The atomization of the solution is obtained using a nitrogen/hydrogen mixture at a temperature equal to at least that of the enclosure. (France)

45941 IMPROVEMENTS IN OR RELATING TO WELDING FLUX COMPOSITIONS FOR SUBMERGED ARC WELDING AND METHODS OF MAKING THE SAME. (to Council of Scientific and Industrial Research). Indian Patent 114,500. 13 Aug 1969.

The flux is comprised of lime, silica, magnesia, alumina, manganese oxide, chromium sesquioxide, molybdenum oxide, titanium dioxide, zirconium dioxide, and fluorine. (Indian Sci. Abstr.)

45942 HYDROGEN GENERATORS FOR NEUTRON TUBES. Bobrowski, Czeslaw; Gutowski, Ryszard; Korytowski, Adam; Milosz, Jacek. Elektronika; 8: No. 4, 148-51(1972). (In Polish).

Information concerning hydrogen and metal reactions is presented especially in the case of Ti and Zr. The particular requirements applying to hydrogen generators for neutron tubes are formulated and design methods are described. (auth)

45943 CRYSTALLIZATION OF BeO, Be_2SiO_4, AND SiO_2 FROM Li_2MoO_4–MoO_3. Osmer, Judith A.; Chase, A. B. (Aerospace Corp., El Segundo, Calif.). J. Amer. Ceram. Soc.; 55: No. 6, 292-5(Jun 1972).

Single crystals of phenacite (Be_2SiO_4), bromellite (BeO), and tridymite (SiO_2) were grown from an $Li2MoO_4-MoO_3$ flux. Phenacite, with rhombohedral symmetry, grew in three distinct shapes with aspect ratios (length/width) as follows: needles (>3), rods (>1.1 to 1.5), and rhombohedral-faced crystals (=1). The latter grew as single crystals; the others were twinned on the (1010). For most experiments the temperature was held constant at 1165°C and the Li_2MoO_4/MoO_3 ratio at 1/16. The growth mechanism for crystallization was the evaporation of MoO_3. The system produced one to three phases, depending on the BeO/SiO_2 ratio. Bromellite grew until a BeO/SiO_2 ratio of 0.8 was attained. It grew as a hemipyramidal crystal having a short prism with a curved $(000\bar{1})$ top or as a hexagonal plate. The pyramid- and prism-shaped crystals were twinned, although a few hexagonal plates were single. Tridymite grew in small hexagonal plates when the BeO/SiO_2 ratio was less than 1.5. The effects of temperature, nucleation, and flux composition on crystal shape, twinning, and occurrence are discussed. (auth)

45944 CRITICAL SURFACE ENERGIES OF Al_2O_3 AND GRAPHITE. Rhee, S. K. (Bendix Corp., Southfield, Mich.). J. Amer. Ceram. Soc.; 55: No. 6, 300-3(Jun 1972).

Based on the wetting properties of α-Al_2O_3 and pyrolytic graphite by liquid metals, the critical surface energy for spreading was determined and compared with the surface energy of the ceramics. The surface energy γ_s (ergs/cm^2) of the (0001) surface of α-Al_2O_3 was estimated to be $892-0.12T$ (°C), that of the c plane of pyrolytic graphite $1139-0.13T$ (°C), and that of the α plane of pyrolytic graphite $1300-0.17T$ (°C). Also, the liquid-solid interfacial energies were calculated and found compatible with the values reported in the literature. The surface energy of liquid Ag or liquid Cu was not significantly affected by carbon. (auth)

45945 PHASE ANALYSIS IN ZIRCONIA SYSTEMS. Garvie, Ronald C.; Nicholson, Patrick S. (McMaster Univ., Hamilton, Ont.). J. Amer. Ceram. Soc.; 55: No. 6, 303-5(Jun 1972).

Linear calibration curves were developed for determining the content of free ZrO_2 in partially stabilized zirconia ceramics by x-ray diffraction techniques. The systems $CaO-ZrO_2$ and $MgO-ZrO_2$ were studied by two methods. The matrix method, in which free ZrO_2 was considered to be distributed in a matrix (the cubic phase), gave approximately equal mass absorption coefficients for the monoclinic and cubic phases. The polymorph technique, in which the cubic phase was considered to be a polymorph of ZrO_2 and in which integrated intensities were used, gave the better results. (auth)

45946 DIFFUSION IN THE SYSTEM K_2O–SrO–SiO_2. III. INTERDIFFUSION COEFFICIENTS. Varshneya, A. K.; Cooper, A. R. (Case Western Reserve Univ., Cleveland). J. Amer. Ceram. Soc.; 55: No. 6, 312-17(Jun 1972).

The matrix of interdiffusion coefficients, [D], was determined by measuring spatial composition distribution in couples with compositions (in weight fractions) near $0.21K_2O-0.17SrO-0.62SiO_2$ after they were heat-treated for various times at 630 to 810°C. The results were consistent with the Onsager hypothesis in that [D] at a given temperature was independent of diffusion time and the direction (in composition space) of the diffusion couple. The eigenvectors and eigenvalues of the [D] matrix were determined; the diffusion paths in composition space are thus easily understood. As is consistent with intuition, the "fast" eigenvector nearly paralleled the direction of constant SiO_2 concentration. (auth)

45947 KINETICS AND BURST PHENOMENON IN ZrO_2 TRANSFORMATION. Maiti, H. S.; Gokhale, K. V. G. K.; Subbarao, E. C. (Indian Inst. of Tech., Kanpur, India). J. Amer. Ceram. Soc.; 55: No. 6, 317-22(Jun 1972).

The monoclinic–tetragonal transformation in ZrO_2 was studied by DTA. The reverse transformation occurred at 850 to 1000°C, depending on the crystallite size, which was a function of the experimental variables. Isothermal kinetics were exhibited by material containing small crystallites; athermal behavior began to appear as the crystallite size increased. On cooling, strain-free samples underwent a very rapid transformation which was evident as a burst. (auth)

45948 PREPARATION OF TRANSPARENT Y_2O_3-DOPED ThO_2. Greskovich, C.; O'Clair, C. R.; Curran, M. J. (General Electric Corp., Schenectady, N. Y.). J. Amer. Ceram. Soc.; 55: No. 6, 324-5(Jun 1972).

A powder preparation and processing method is described for production of Y_2O_3-doped ThO_2 (YDT) ceramics with high optical quality. Microstructural and optical features of the sintered product are also presented. The results showed that grain size and porosity in YDT ceramics increased as the Y_2O_3 content increased from 5 to 15 mole %. Therefore, it is proposed that the induction period required for the onset of discontinuous grain growth is longer in ThO_2–5 mole % Y_2O_3 than in ThO_2–15 mole % Y_2O_3, and fewer sites for discontinuous grain growth are present in the latter material than in the former. (P.C.H.)

45949 SURFACE TENSION, DENSITY, AND VOLUME CHANGE ON MELTING OF Al_2O_3 SYSTEMS, Cr_2O_3, AND Sm_2O_3. Rasmussen, J. J. (Battelle-Northwest, Richland, Wash.). J. Amer. Ceram. Soc.: 55: No. 6, 326(Jun 1972).

An x-radiographic method was used to obtain data on surface tension, density, and volume change on melting of Al_2O_3, Al_2O_3–MgO, Y_2O_3–Al_2O_3, Sm_2O_3–Al_2O_3, Sm_2O_3, and Cr_2O_3. Measurement of the volume change on melting by the radiographic method had the advantage that the thermal expansion of the sample was measured in both the solid and the liquid states. Oxide additives to Al_2O_3 reduced the volume change on melting significantly. The Sm_2O_3 and Y_2O_3 were much more effective in reducing the volume change than the MgO. Data are tabulated. (P.C.H.)

45950 ACOUSTIC VELOCITY MEASUREMENTS IN THE METAL HYDRIDES, $ScH_{1.99}$, $YH_{1.93}$, AND $ErH_{1.81}$. Beattie, A. G. (Sandia Labs., Albuquerque, N. Mex.). J. Appl. Phys.; 43: No. 7, 3219-21(Jul 1972).

Longitudinal and shear velocities were measured as a function of temperature in polycrystalline samples of $ScH_{1.99}$, $YH_{1.93}$, and $ErH_{1.81}$. From these measurements values of the limiting Debye temperature, θ_0, the bulk modulus, Young's modulus, the shear modulus, and Poisson's ratio are calculated. (auth)

45951 NEW ELECTRICAL PROCEDURE FOR THE COMPACTION OF TECHNICAL POWDERS. Jacobi, Siegfried; Schneider, Rolf; Tradowsky, Klaus Elektrotech. Z., A; 92: No. 8, 486-8(Aug 1971). (In German). (KFK-1492).

A compaction procedure through which powder particles are exposed to a high, electrodynamically-produced acceleration of 20×10^3 g is described. In contrast to usual procedures, compaction occurs without external application of pressure. By this method, relatively large rods can be obtained with homogenous and high densities approaching approximately 70% of theoretical values. The procedure was tested on powdered Al_2O_3 and UO_2 as well as on metallic powders of carbonyl iron and molybdenum. (tr-auth)

45952 DYSPROSIUM BOROCARBIDES. Bauer, Josef; Debuigne, Jean (Institut National des Sciences Appliquees, Rennes, France). Compt. Rend., Ser. C; 274: No. 13, 1271-4(27 Mar 1972). (In French).

A ternary Dy–B–C system was studied using x-ray diffraction and metallography on samples quenched after melting. The existence of the DyB_2C_2, DyB_2C, DyBC and Dy_2BC_2 phases was verified. The structure of the three first phases and that of the YB_2C_2, YB_2C, and YBC phases are isotypic. A unit cell is proposed for Dy_2BC_2. (France)

45953 HEXAVALENT W BRONZES CONTAINING Th IN INTERSTITIALS: $Th_x^{IV}{}_{/4}(B_x^{V}W_{1-x}^{VI})O_3$ PHASES (B = Nb, Ta). Feneyrol, J. Y.; Sabatier, Rene; Baud, Gilbert (Univ., Clermont-Ferrand, France). Compt. Rend., Ser. C; 274: No. 11, 1059-62(13 Mar 1972). (In French).

Two new bronze type phases were observed in both the $Th_{x/4}(Nb_xW_{1-x})O_3$ and the $Th_{x/4}(Ta_xW_{1-x})O_3$ systems. A tetragonal phase with a WO_3-like structure occurs at high temperature along with a cubic phase of the perovskite-type. Their domains of homogeneity were investigated and the cubic structure of the perovskite phase, having the space group Pm3m, was crystallographically verified. (France)

45954 PHASES OF SCHEELITE STRUCTURE IN THE SYSTEMS OF PLUTONIUM MOLYBDATE–LITHIUM OR SODIUM MOLYBDATE. Tabuteau, A.; Pages, M.; Freundlich, W. (Institut du Radium, Paris). Mater. Res. Bull.; 7: No. 7, 691-7 (Jul 1972). (In French).

A molybdate of tetravalent plutonium has been identified and the systems $Pu(MoO_4)_2$–Na_2MoO_4 and $Pu(MoO_4)_2$–Li_2MoO_4 have been studied by means of liquid-solid equilibrium diagrams and x-ray diffraction. Three phases have been found: $Na_2Pu(MoP_4)_3$ with a scheelite structure, and $Na_4Pu(MoO_4)_4$ and $Li_4Pu(MoO_4)_4$ with a scheelite superstructure. These compounds were isostructural with the corresponding neptunium compounds. (auth)

45955 SPECIAL TECHNIQUES FOR THE METALLOGRAPHIC EXAMINATION OF HARD METALS. Arndt, Renate; Hillnhagen, Emil (Krupp Forschunginstitut, Essen). Prakt. Metallog.; 9: No. 6, 309-17(Jun 1972). (In German and English).

With the help of a continuous band interference filter, phase pictures can be produced of hard metal specimens coated with ZnSe having particular advantages for quality control. By vapor-phase deposition of C and Au and an appropriate astigmatism correction applied individually to the relevant points on the specimen, satisfactory scanning electron micrographs of hard metals can be produced. An electrolytic polishing technique for hard metals (polished specimens) has been developed. Using an acidic polishing solution in the double jet technique, thinned specimens were produced of WC-Co and WC-(Ti,W) C-Co hard metals containing regions transparent to electrons in all existing phases. Experiments on the thinning of hard metals by ion bombardment produced very promising results. (auth)

45956 STUDY OF ACTIVATED SINTERING MECHANISM OF UO_2 POWDER BY HIGH TEMPERATURE X-RAY DIFFRACTOMETRY. Lee, Byoung Whie; Suh, Kyung Soo (Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 4: No. 2, 132-6 (Jun 1972).

The mechanism for activated sintering of UO_2 by an addition of 0.05 wt % TiO_2 was investigated using a high temperature x-ray diffractometer. The diffraction pattern of UO_2 pellets was studied in a temperature range from room temperature to 1200°C in hydrogen atmosphere. At 1200°C, the expansion of UO_2 lattice was 1.448 and 1.354% greater when it was compared with those at room temperature for pellets with and without the 0.05 wt % TiO_2 addition, respectively. The effects of the TiO_2 addition were to increase the lattice constant of UO_2 by 0.094% at 1200°C. The lattice constant at 1200°C without the TiO_2 addition was equal to that at 1080°C with the 0.05 wt % TiO_2 addition. This temperature difference could be well compared with the suppression of sintering temperature by TiO_2 that had been observed previously. It is believed that the increase in lattice expansion due to the TiO_2 addition would give rise to the activated sintering of UO_2 by the lattice-expansion-induced-enhancement of self diffusion. (auth)

45957 NUCLEAR FUEL COMPRISING URANIUM DIOXIDE IN A POROUS CERAMIC OXIDE MATRIX. Burke, Thomas J.; Belle, Jack; Clayton, John C. (to United States Atomic Energy Commission). U. S. Patent 3,657,137. 18 Apr 1972. Filed 4 Jun 1964.

A new ceramic-type nuclear fuel consisting of particles of uranium dioxide embedded in a matrix of zirconium oxide, in which the uranium dioxide particles are partially separated from the matrix by an annular void is prepared by mixing uranium trioxide with calcium-oxide-containing zirconium dioxide powder and a small quantity of a binder, pressing the mixture, and firing the mixture in an atmosphere of hydrogen. (Official Gazette)

45958 METAL OXIDE FILM STRUCTURE. Aladjem, Abraham (to Israel Atomic Energy Commission). U. S. Patent 3,675,021. 4 Jul 1972. Priority date 26 Sep 1968, Israel.

The invention provides metal oxide film structures for use as radiation windows, membranes of electrolytic cells, and other purposes. The structures consist of an annular, or other closed frame of tantalum, niobium, tungsten, or zirconium integral with a thin film of an oxide of the same metal, which spans the area enclosed by the frame. The structure is manufactured by subjecting a blank of the metal concerned, centrally masked on the larger part of the surface, to an anodizing treatment producing the oxide on all unmasked parts, removing the mask and subjecting the oxide-covered blank, as anode, to an electrolytic process by which the unoxidized metal except the frame, is dissolved. (Official Gazette)

45959 COATED-PARTICLE FUEL AND FERTILE ELEMENT FOR NUCLEAR REACTORS AND METHOD OF OPERATING SAME. Boettcher, Alfred. U. S. Patent 3,669,852. 13 Jun 1972. Priority date 17 Jan 1967, Germany.

A fuel element is described for nuclear reactors which comprises coated fuel and breeder particles in which coated particles containing the fuel have diameters of at most half the diameters of coated particles containing the fertile material. The coated particles are embedded in a graphite shell or received in a vacuum-tight metal shell. The different sizes of the coated particles containing the fuel and fertile material is the basis for mechanical discrimination between them. (Official Gazette)

45960 NITRIDE FUELS: PROPERTIES AND POTENTIALS. Bauer, Arthur A. (Battelle Memorial Inst., Columbus, Ohio). Reactor Technol.; 15: No. 2, 87-104(1972).

Interest in nitride fuels centers principally on the use of (U,Pu)N in fast breeder reactors. A review of nitride fuel properties is presented including properties and irradiation behavior of UN, whose major potential application is as a space reactor fuel. Information on UN as presented here serves principally as background to, and to supplement, data on mixed-nitride, (U,Pu)N, fuels. Although the mixed nitrides have received less concentrated study, a sufficient technology base appears to exist that will permit an evaluation of mixed nitrides as liquid-metal-cooled fast breeder reactor fuels. The properties of (U,Pu)N related to its irradiation performance, safety characteristics, and fuel-cycle costs are reviewed. Fuel-pin design is discussed, and fuel-performance potential and limitations are outlined. Emphasis is placed on potential advantages resulting from the use of (U,Pu)N to fuel an advanced liquid-metal-cooled fast breeder reactor. (auth)

45961 THERMODYNAMICS OF RARE-EARTH-CARBON SYSTEMS. IV. THE LUTETIUM–CARBON SYSTEM. Guido, M.; Balducci, G.; De Maria, G. (Univ., Rome). J. Chem. Phys.; 57: No. 4, 1475-9(15 Aug 1972).

The vaporization of the lutetium dicarbide–carbon system was investigated by the Knudsen effusion–mass spectrometric technique over the temperature range 2100 to 2600°K. Lu(g) partial pressures, dissociation energies for $LuC_2(g)$ and $LuC_4(g)$ molecules, and the standard heat of formation for $LuC_2(s)$ were obtained. (auth)

45962 FERROELECTRICS IN THE K_2O–SrO–Nb_2O_5 SYSTEM. Ainger, F. W. (Allen Clark Research Centre, Towcester, Eng.); Beswick, J. A.; Porter, S. G.; Clarke, R. Ferroelectrics; 3: 321-5(1972).

Research into the tungsten bronze phase field of the K_2O–SrO–Nb_2O_5 system (KSN) has shown that ferroelectricity occurs over a wide range of compositions close to the $KNbO_3$–$SrNb_2O_6$ binary line. The approximate location of the congruently melting composition was found by chemical and x-ray analyses of crystals produced from vertical float zoning and Czochralski pulling experiments and was centered on $K_2Sr_3Nb_{10}O_{30}$. This composition gave crystals of much improved optical quality—free from striae but containing vertical structure. $K_2Sr_3Nb_{10}O_{30}$ crystals have distinctive dielectric properties, the dielectric constant of poled crystals being half that of the as-grown ones. The true lattice spacing in the "c" direction was double that of the basic tetragonal unit cell and may be explained in terms of tilted NbO_6 octahedra. The low half-wave voltage and dielectric properties of $K_2Sr_3Nb_{10}O_{30}$ make it potentially useful for electro-optic and pyroelectric applications However, the reproducibility of striae free crystals pulled from the melt has not been proven. (auth)

45963 Al–Fe–Mo OXIDE CATALYSTS. I. THE OXIDE SYSTEM Al_2O_3–Fe_2O_3 AND Fe_2O_3–MoO_3. Khakimov, U. B.; Talipov, G. Sh.; Samigov, K. A.; Rakhmatullaev, N.; Abidova, M. F. Zh. Obshch. Khim.; 42: No. 2, 259-61(Feb 1972). (In Russian).

Infrared spectroscopy, EPR, and x rays were used in an examination of the systems Fe_2O_3–MoO_3 and Al_2O_3–MoO_3 after heating the binary systems to 600°C for 6 hr. It was established that the compounds $Al_2(MoO_4)_3$ and $Fe_2(MoO_4)_3$ had been formed. In an x-ray examination of the system Al_2O_3–Fe_2O_3 traces of the spinel $FeAl_2O_4$ were found. This evidence suggests that Fe–Al–Mo catalysts represent complex, multiphase systems. (K.S.W.)

45964 BOROCARBIDES OF THULIUM, LUTETIUM, TERBIUM, YTTERBIUM, AND SOME OF THEIR PROPERTIES. Bezruk, E. T.; Markovskii, L. Ya. J. Appl. Chem. USSR (Engl. Transl.); 45: No. 1, 1-3(Jan 1972).

Translated from Zh. Prikl. Khim.; 45: No. 1, 3-6(Jan 1972).

The existence of thulium and lutecium borocarbides having the composition LnB_2C_2, with a tetragonal structure, was demonstrated. The only ternary compounds formed by the metals Tm, Lu, Tb, and Yb with carbon and boron at 1500 to 2100° are borocarbides of the LnB_2C_2 type. No other borocarbides were found for these rare earth elements. (auth)

45965 STRUCTURE OF BINARY SILICIDES. Matyushenko, N. N. Rev. High-Temp. Mater.; 1: No. 2, 203-53(1972).

The table of structure data for binary silicides $MeSi_x$ was published in book form (Kristallicheskie Struktury Dvoinykh Soedinenii) by the Metallurgia Publishing House, Moscow, in 1969. The figure showing the relative change in volume as a function of the atomic number of the second component is from the same source. The table comprises data on the composition, the second-component content, the structure type and system, the number of formula weights per unit cell, the lattice parameters, the theoretical and experimental densities, the formula volume of the binary compound and its difference from the formula volume of the second component Me. The temperature at which the measurement was made (or the temperature range of stability) is given, where available. (auth)

Metals and Alloys

Refer also to abstract: 45311.

Corrosion and Erosion

Refer also to abstracts: 45461, 45487, and 45935.

45966 (BMI–1927) STRESS-CORROSION CRACKING OF SENSITIZED STAINLESS STEEL IN OXYGENATED HIGH-TEMPERATURE WATER. White, Earl L.; Berry, Warren E.; Boyd, Walter K. (Battelle Columbus Labs., Ohio). Jun 1972. Contract W-7405-eng-92. 66p. Dep. NTIS.

The intergranular stress-corrosion cracking behavior of sensitized austenitic stainless steels has been studied in water at 288°C containing 0.2, 1, 10, and 100 ppM dissolved oxygen and to a lesser extent in 288°C water first adjusted to pH 10 with NH_3 and then to pH 5 with CrO_3. Sensitized Type 304 stainless steel exposed to an accelerated test containing 100 ppM dissolved oxygen cracked within a few days at stress levels of 2 Sm and 3 Sm and after 83 days at Sm (Sm = 0.9 yield strength). Mill-annealed material did not fail at 3 Sm loadings after 84 days' exposure to this same environment. On the other hand, only highly stressed (3 Sm) sensitized Type 304 stainless steel failed (217 days) in long-term exposures of up to 450 days in simulated BWR water containing 0.2 ppM oxygen. Sensitizing treatments of 7 or 24 h at 621°C or a furnace cool from 1038°C produced a high degree of susceptibility to cracking in Type 304 stainless steel in oxygenated water. Agglomerating or locally homogenizing the Type 304 steel at 816°C prior, or subsequent, to sensitizing at 621°C improved its resistance to cracking in oxygenated water, although abrading the surface of these specimens to remove a heavy tarnish film may have influenced the results. Abrading or liquid honing the surface of the Type 304 steel improved its resistance to cracking in oxygenated water, while pickling in HF–HNO_3 made it more susceptible to cracking under these conditions. Prestraining the Type 304 stainless steel did not increase its susceptibility to cracking in oxygenated water. The addition of 1 or 10 ppM fluoride to water containing 10 ppM oxygen had no effect on the susceptibility of sensitized stainless steel to stress-corrosion cracking. Sensitized, wrought, Types 304, 309, and 316 stainless steel were about equally susceptible to stress-corrosion cracking in oxygenated water. On the other hand, "sensitized" Type 304L, Type 308L weld deposit, Type 347, Incoloy 800, and Inconel 600 were resistant to the same conditions that produced rapid stress-corrosion failures of Type 304 in oxygenated water. Inconel 625 bellows failed by stress-corrosion cracking at the crevice formed by the inside bend of the bellows. Aerated or deaerated simulated off-chemistry PWR water, where the initial pH 10 (NH_3) was adjusted to pH 5 with CrO_3, did not produce stress-corrosion cracking of sensitized Type 304 stainless steel at the same stress levels and exposure times that produced rapid cracking in oxygenated water (100 ppM oxygen). (auth)

45967 PASSIVITY OF TYPE 304 STAINLESS STEEL: EFFECT OF PLASTIC DEFORMATION. Elayaperumal, K.; De, P. K.; Balachandra, J. (Bhabha Atomic Research Centre, Bombay). Corrosion; 28: No. 7, 269-73(Jul 1972).

The passivity of Type 304 austenitic stainless steel, as affected by plastic deformation, was studied by obtaining the potentiostatic anodic polarization curves of annealed and cold worked materials in hydrogen saturated 1N H_2SO_4 at room temperature. While the effect of 26% cold work is not significant, 50%, and 68% cold work make the attainment of passivity more difficult by shifting the open circuit potential in the active direction and increasing the critical current density. Studies on passive current versus time indicate that cold work does not affect the initial passive current, but the extent of decrease of passive current with time is less for the cold worked material than the annealed material. These results seem to be related to the strain-induced bcc martensite which forms when the metastable austenitic stainless steel is cold worked. This martensitic phase, the presence of which has been checked by x-ray and metallography, has a high critical current density for passivity. Also, the active dissolution of a ferritic stainless steel, which does not transform to martensite, is not affected by cold work. (auth)

45968 EROSION OF A TUNGSTEN CATHODE IN NITROGEN. Zhukov, M. F.; An'shakov, A. S.; Dandaron, G.-N. B.; Sazonov, M. I. (Inst. of Heat Physics, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, No. 8, Ser. Tekh. Nauk; No. 2, 7-12(Jun 1971). (In Russian).

The effectiveness of a protective nitrogen blanket on the destructive action of large plasmatron currents on a thoriated tungsten cathode was investigated. Tungsten rods 4 to 9 mm in diameter functioned as the cathode for currents ranging from 200 to 1,000 A. In experiments lasting for 0.5 to 2.5 h, specific erosion of a 4mm diameter tungsten cathode in N_2 lay in the interval 3×10^{-9} to 1×10^{-8} g A^{-1} sec^{-1}. (K.S.W.)

45969 KINETICS OF SOLID VANADIUM–NITROGEN REACTION AT HIGH TEMPERATURES. Muije, Pieter. Pullman, Wash.; Washington State Univ. (1972). 72p. University Microfilms Order No. 72-18,479.

Thesis.

Thermogravimetric, metallographic, and x-ray diffraction studies were made of the kinetics and mechanisms of the reaction between high-purity vanadium sheet and purified nitrogen gas. Nitriding was carried out isothermally in the temperature range of 900 to 1450°C at pressures between 700 and 7×10^{-2} torr for 160 hours maximum. The kinetic data obeyed either the parabolic, cubic, or linear empirical rate equation during limited time intervals. The general expression for the integral form of these rate equations is: $(\Delta W/A)^m = b\ T\ e^{-Q/RT}\ t + C(T)$ where $\Delta W/A$ is the weight gain per unit surface area, b a constant, T the absolute

temperature, Q the activation energy, R the universal gas constant, t the elapsed time, and C the integration constant. The exponent m is 1, 2, or 3 for the linear, parabolic, or cubic rate equation. During nitriding below 1150°C at 700 torr, the weight gain showed a parabolic time dependence except for the first few minutes. At 1150°C and above, the reaction was first parabolic, but was then followed by a cubic stage. Lowering the pressure from 700 to 70 torr did not affect the reaction kinetics. However, lowering the pressure further to 7×10^{-1} torr caused the cubic reaction to disappear and reduced the parabolic reaction rates. During nitriding at the lowest pressure of 7×10^{-2} torr, the linear in addition to the parabolic time dependence of weight gain was observed. The weight gains during the parabolic reactions were primarily reflected by the diffusion of nitrogen into the vanadium to form a solid solution, with a small amount of nitrogen combining with vanadium to form a thin compact V_3N layer. The activation energy for the parabolic reaction was independent of temperature and pressure and was 38,700 cal/mole. The cubic reaction was related to the formation of a compact layer of VN at the surface. The VN formed on the V_3N which in turn formed on the saturated solid solution of nitrogen in vanadium. The activation energy for the cubic reaction was also independent of temperature and pressure and was 49,800 cal/mole. The linear reaction, which was sometimes observed initially at 7×10^{-2} torr, seemed to be related to a rate-controlling surface mechanism. (Diss. Abstr. Int., B)

45970 EFFECT OF HEAT TREATMENTS ON THE CORROSION OF 18/10 STAINLESS STEELS WITH LOW C CONTENTS IN NITRIC MEDIUM IN THE PRESENCE OF FERRIC IRON. Blanchet, J.; Coriou, H.; Grall, L.; Pelras, M.; Nakajima, N. (CEN, Fontenay-aux-Roses, France). Mem. Sci. Rev. Met.; 69: No. 3, 193-8(Mar 1972).

In the presence of boiling 2N nitric acid containing 40 g l^{-1} of iron nitrate, 18/10 stainless steels with low C contents (0.012 and 0.023%) exhibited intergranular corrosion after annealing; the corrosion increased with the carbon contents. This phenomenon, which is due to the presence of ferric ions, was not encountered when the steels were adequately superquenched; a generalized dissolution of the metal was observed in this case, which increased when ferric ions were added to the medium. Such corrosion must be taken into account in welded structures. (France)

45971 VANADIUM OXIDATION IN THE PRESENCE OF MOISTURE. Varhegyi, Gyozo; Fekete, Istvanne; Vitanyi, Palne; Imre, Aladarne. Femip. Kut. Intez. Kozlem.; 10: 203-13(1971). (In Hungarian).

The oxidation process on vanadium sponge produced by magnesium reduction during storage was investigated. On the basis of model experiments, gas analysis, and x-ray diffraction it has been stated, that the oxidation of vanadium sponge is caused first of all not by the oxygen content, but by the water vapor content of the air. Rules to prevent oxidation are listed. (auth)

Preparation and Fabrication

Refer also to abstract: 45406.

45972 (COO-3311-1) FORMING OF COMPOSITE FOR SUPERCONDUCTING ROD. Technical Progress Report. Hahn, W. C. Jr.; Avitzur, Betzalel (Lehigh Univ., Bethlehem, Pa. Dept. of Metallurgy and Materials Science). 25 Feb 1972. Contract AT(11-1)-3311. 7p. Dep. NTIS.

Research directed to production of Nb-44 wt% Ti wire clad with an Al sleeve is described. Effort during the report period was devoted to determining the effect of core-to-sleeve ratio on production of sound specimens. Processes were developed for production of an Al single-cored rod in which the hard wire core is inserted. (J.R.D.)

45973 (ORNL-RMIC-12) COMPILATION OF CRYSTAL GROWERS AND CRYSTAL GROWTH PROJECTS. Connolly, T. F. (Oak Ridge National Lab., Tenn.). Jun 1972. Contract W-7405-eng-26. 142p. Dep. NTIS.

A compilation of organizations distributed throughout the world engaged in activities associated with crystal growth is presented. Materials and applications indexes are included. Four hundred forty-one entries are included. (J.R.D.)

45974 PLUTONIUM FUEL PRODUCTION PLANT AND BREEDER PROJECTS. Vandem Bemden, E.; Lafontaine, I. (Societe Belge pour l'Industrie Nucleaire, Brussels). Energ. Nucl. (Paris); 14: No. 1, 29-32(1972). (In French).

In conjunction with the CEN-MOL laboratories, Belgonuclear has studied the problems connected with the use of Pu as a nuclear fuel. This company has also developed a pilot production plant. In addition a Pu fuel production plant has been built at Dessel and will be put into service in the near future. It is envisaged that this plant will provide the Pu enriched rods for the SNR core. (France)

45975 ELECTRON TRANSFER DURING ZONE MELTING OF YTTRIUM. Ivantsov, I. I.; Mashkarova, V. T.; Lavlov, V. S.; Saenko, E. M. Izv. Akad. Nauk SSSR, Metal.; No. 1, 114-18 (1972). (In Russian).

The distribution of impurities during the refining of Y by zone melting was studied. All impurities analyzed, both metallic and gaseous, migrated to the anode portion. Zone melting of Y in an electric field removed most impurities, the degree of purification increased with the number of passages and the time of electrotransfer. It was concluded that zone melting can result in coarse single Y crystals of technical purity. (K.S.W.)

45976 MECHANISM OF SINTERING IN COBALT–RARE-EARTH PERMANENT-MAGNET ALLOYS. Benz, M. G.; Martin, D. L. (General Electric Research an Development Center, Schenectady, N. Y.). J. Appl. Phys.; 43: No. 7, 3165-70(Jul 1972).

Observations of composition, temperature, and time effects during the sintering of cobalt–samarium permanent-magnet alloys are presented. A correlation between the conditions which lead to the onset of rapid shrinkage during sintering and the conditions which lead to a high H_{ci} is noted. A model for the mechanism of shrinkage during sintering is postulated where the slow step is the diffusion of samarium atoms in the grain-boundary regions via a samarium-atom–cobalt-vacancy cluster exchange mechanism. Furthermore, it is suggested that the "high" H_{ci} structures achieved in these alloys would appear to be those with a relatively high concentration of cobalt vacancies in the grain-boundary regions. (auth)

45977 STUDY OF ELECTROLYTIC DEPOSITION OF TUNGSTEN–COBALT ALLOYS. Yur'ev, B. P.; Kiseleva, L. S.; Zabelin, I. V. (Leningrad Polytechnic Inst.). J. Appl. Chem. USSR (Engl. Transl.); 45: No. 1, 79-82(Jan 1972).

Translated from Zh. Prikl. Khim.; 45: No. 1, 85-9(Jan 1972).

A study of cathodic polarization curves for joint reduction of tungsten, cobalt, and hydrogen in mixed $Na_2WO_4 + CoSO_4$ solutions with additions of ammonium citrate, in relation to the solution composition and temperature, showed that formation of W–Co electrolytic alloy on the cathode is accompanied by considerable depolarization of both components simultaneously. Current efficiency for the alloy increased with decrease of current density and with rise of temperature. The tungsten content in the alloy increased appreciably with rise of temperature; current density had considerably less influence on the alloy composition. The value of α for tungsten was close to the theoretical if it was assumed that reduction of WO_4^{2-} ions to the metal proceeds by stages, the one-electron process being the determining (slowest) step. It was found by x-ray structural and microscopic investigations of the electrolytic alloys that alloys containing 50% tungsten (by weight) contain in their structure an ϵ' phase (solid solution of tungsten in cobalt) and the chemical compound Co_3W, and are consistent in structure with the phase diagram of the W–Co system. It is suggested that alloy formation at the cathode is one of the determining factors in depolarization and determines the possibility of reduction of tungsten jointly with other metals at the cathode. (auth)

45978 ELECTROCHEMICAL REDUCTION OF URANIUM(VI) TO URANIUM(IV) IN SULFURIC ACID SOLUTIONS. Stabrovskii, A. I.; Slepchenko, I. G. J. Appl. Chem. USSR (Engl. Transl.); 45: No. 1, 101-6(Jan 1972).

Translated from Zh. Prikl. Khim.; 45: No. 1, 110-15(Jan 1972).

It was found with the aid of polarization curves that, dependent on the cathode potential, formation of U(IV) in solution may proceed by reduction of U(VI) to U(IV) at the cathode as the result of disproportionation of U(V), or by interaction of U(VI) with U(III) in the bulk solution. (auth)

45979 Zr Hf NEWSLETTER, JUNE 1972. Akron, N. Y.; AMAX Specialty Metals Division (1972). 18p.

Developmental and other information is summarized on Hf and Zr metal, Zr-base alloys, use of Zr as an additive to other alloys, and production of Zr oxides and silicates. Information is also included on Zr borides, carbides, nitrides, germanides, hydrides, sulfides, selenides, silicides, and tellurides. 316 references are included. (J.R.D.)

45980 SURFACE PREPARATION OF URANIUM PARTS. de Vaulchier du Deschaux, Louis; de Fouchier, Alain; de Vaucelles, Emmanuel; Facquet, Louis (to Commissariat a l'-Energie Atomique). U. S. Patent 3,674,655. 4 Jul 1972. Priority date 24 Jan 1968. France.

Prior to electroplating parts of uranium or uranium base alloys, the parts are subjected to a surface preparation, the preliminary steps involve chemical degreasing, electrolytic degreasing, and if necessary chemical etching and an anodic electrolytic treatment in an aqueous solution of an organic salt or a sulphate of lithium and/or magnesium. (Official Gazette)

45981 VACUUM INDUCTION MELTING. Schlatter, R. J. Metals; 24: No. 5, 17-25(May 1972).

The increase of vacuum-induction melting (VIM) capacity is closely related to the continuing growth in the use of superalloys for thermal engines, which in turn stimulated the development of a large variety of wrought and cast alloys. The presence of substantial amounts of reactive elements and the requirements of complete chemistry control (alloy composition, beneficial trace elements, and harmful impurities) to very narrow tolerances as well as exceptional cleanliness justify the application of this melting technique. VIM is an expensive operation, even in large furnaces of advanced design with many operational improvements. But there is no other proven primary industrial melting process providing the exact metallurgical conditions necessary for the reliable and consistent production of the great variety of these complex alloys. The physicochemical aspects of the VIM process are well understood today, but for various reasons the practice does not generally appreciate the importance of this valuable knowledge, and its full utilization is lacking. Much progress has been made in the area of refractory technology, but more work is needed, particularly in developing new types of refractory materials or ceramic systems to extend the metallurgical potential of the process and improve the operational efficiency. The shortcomings of the VIM process regarding casting and solidification control are difficult to overcome, hence the three-step manufacturing process with final consumable electrode vacuum arc remelting—or electroflux remelting—will remain technically, metallurgically, and economically the most flexible approach, providing exceptional overall quality and integrity in these sophisticated superalloys. (auth)

45982 RECRYSTALLIZATION OF METALS OF HIGH PURITY. Chaudron, Georges (Univ., Paris). J. Less-Common Metals; 28: 175-85(1972). (In French).

It is known that studies on the recrystallization of metals have generally had the practical purpose of preparing single crystals. In the very ingenious method of Burgers and Tiedema, it is possible to make single crystals of pre-determined orientation. Professor Burgers has studied the progress of recrystallization by various methods: x-ray diffraction and optical microscopy. The influence of purity on the conditions under which the polygonized state appears is pointed out. The existence of a critical polygonization temperature was first found in the case of aluminium. The polygonization of iron has been studied as a function of purity. In the case of zone-refined iron, the subgrains formed were highly perfect. Studies on the polygonization of copper, which were made possible by the availability of samples with a range of increasing purities, are described. By thermal cycling, the polygonized structure underwent modifications above a certain critical temperature. This temperature was strongly purity-dependent. In conclusion, the polygonized state appeared to occupy a domain of metastability which was distinct from the recrystallized state. (auth)

45983 INFLUENCE OF TEMPERATURE ON ELECTRODEPOSITION OF TUNGSTEN–COBALT ALLOY. Zabelin, I. V.; Yur'ev, B. P. J. Appl. Chem. USSR (Engl. Transl.); 45: No. 1, 197-9(Jan 1972).

Translated from Zh. Prikl. Khim.; 45: No. 1, 205-7(Jan 1972).

Studies were made on the effects of temperature, carried out for determination of the activation energies and kinetic characteristics of the partial processes of reduction of WO_4^{2-} and Co^{2+} ions at the cathode, on the electrolytic deposition of W–Co alloys. Relatively low activation energies were found in both cases, which indicates that the course of the processes is controlled by diffusion. It was concluded that reduction of Co and W under the specific conditions under consideration proceeds in the region of mixed control, i.e., is controlled both by diffusion and by electrochemical factors. (P.C.H.)

45984 GRAIN REFINING OF MAGNESIUM ALLOYS. Emod, Gyula. Femip. Kut. Intez. Kozlem 10: 163-9(1971). (In Hungarian).

Grain refining of magnesium and its alloys was achieved by treating them in a melted state. Treatments were as follows: overheating, chlorination, addition of carbon compounds, etc. Grain refining can be attained by adding certain alloying elements (Zr, Al, Zn etc.). The mechanism of grain refining methods and formation of crystal nuclei on a theoretical basis were also studied. (auth)

Properties, Structure, and Phase Studies

Refer also to abstracts: 45466, 45471, 47248, 47250, and 47263.

45985 (BARC–577) CHEMICAL DIFFUSION IN THE BETA PHASE OF ZIRCONIUM–TITANIUM SYSTEM. Raghunathan, V. S.; Tiwari, G. P.; Sharma, B. D. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 25p. Dep. NTIS (U. S. Sales Only).

Interdiffusion studies were carried out on the bcc phase of zirconium–titanium alloy system using diffusion couples of zirconium and titanium–zirconium alloys. A geoscan electron microprobe was employed to establish the concentration-penetration profiles in the diffusion zones, and the interdiffusion coefficients ($\tilde{D}_{12}$) were evaluated by Boltzmann–Matano analysis. The concentration and temperature dependence of $\tilde{D}_{12}$ were examined. The results showed that the interdiffusion data for the Zr–Ti system in β-phase can be expressed by $\tilde{D}_{12} = A \exp[-(11.2\Delta T_s^{12}/RT)]$ where A is a function of the limiting diffusivity values of two components at infinite dilution, and ΔT_s^{12} is the difference between the solidus temperature and the temperature that would be computed if solidus line varied linearly with composition. This equation is a modified version of Vignes–Birchenall equation applicable to vacancy-controlled interdiffusion in fcc solid solutions. The diffusivity values of Zr in β-Ti and Ti in β-Zr have also been evaluated by extrapolation. The results indicated that interdiffusion in the zirconium–titanium system in the low-temperature range of bcc phase occurs by a vacancy mechanism. (auth)

45986 (BARC–585) ABSORPTION OF CATHODIC HYDROGEN BY IRON AND STEEL. Radhakrishnan, T. P. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 40p. Dep. NTIS (U. S. Sales Only).

Delayed failure and embrittlement due to hydrogen absorption pose intricate problems and limit the application of many high-strength steels in industry and technology. Hydrogen pickup occurs concomitantly during various chemical and electrochemical metal finishing processes and also during galvanic corrosion of the plated steel components. The behavior of cathodic hydrogen in iron and steel and, in particular, the various factors which influence absorption were examined. The mechanism of entry and release of hydrogen was considered on the basis of electrochemical kinetics with due emphasis on the location and state of hydrogen in steel. Methods for studying hydrogen absorption and techniques for evaluating the diffusion coefficient of hydrogen in iron and steel are summarized. A comparison of the data for the diffusivity of hydrogen, obtained by various methods, indicates wide discrepancy and suggests trapping of hydrogen in voids. The effects of pH, poisons, inhibitors, and oxidizing agents on the absorption of hydrogen by steel were examined. The influence of metallurgical factors, such as composition, cold-work, annealing, microstructure of the steel, and applied tensile-stress on hydrogen absorption were considered in some detail. Delayed failure of hydrogenated steel and the theories of embrittlement were also studied. (119 references). (auth)

45987 (CONF-710601–, pp 605-12) VOID FORMATION IN QUENCHED STAINLESS STEEL. Rowcliffe, A. F. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). Apr 1972.

From International conference on radiation-induced voids in metals; Albany, N. Y. (9 Jun 1971).

Disk shaped specimens of five austenitic stainless steels were solution treated at temperatures of 1300 and 1100°C and directly quenched into salt or lead baths held at aging temperatures between 400 and 700°C. In one of the steels, which contained an unusually high phosphorus concentration (18 Cr 10 Ni 0.31 P), vacancy loops and voids were produced; the nature of the defects formed depended upon the solution treatment temperature and on the aging temperature. It was found that there was a critical temperature below which it was necessary to quench in order to nucleate voids. Following solution treatment at 1300°C the critical temperature was between 650 and 700°C; quenching to lower temperatures increased the concentration and decreased the average size of the voids. After solution treatment at 1100°C it was necessary to quench to below 500°C in order to nucleate voids. The observation of voids in quenched stainless steels has not been reported previously. The phenomenon is believed to be the result of a strong phosphorus atom-vacancy interaction which increases the equilibrium vacancy concentration at the solution treatment temperature and greatly modifies vacancy clustering behavior at the aging temperature. (auth)

45988 (CONF-710601–, pp 630-46) SOLUTE SEGREGATION AND STRESSES GENERATED AROUND GROWING VOIDS IN METALS. Anthony, T. R. (General Electrcic Co., Schenectady, N. Y. Research and Development Center). Apr 1972.

From International conference on radiation-induced voids in metals; Albany, N. Y. (9 Jun 1971).

During cooling from a high-temperature anneal, the vacancy supersaturation in a zone neighboring the surface of an aluminum sample reaches the critical point where vacancies begin to precipitate heterogeneously at the metal-oxide interface. The resulting vacancy condensation cavities provide large natural vacancy sinks ($1000\mu^3$) around which any impurity segregation generated by vacancy currents forming these cavities can be directly determined. Vacancy currents were found to cause either enrichment, depletion, or no segregation around the cavities depending on the particular solute addition. From the vacancy and vacancy-generated impurity currents directly measured in these experiments, the ratios of vacancy jump frequencies away from and around impurity atoms in aluminum are determined. Conversely, in other alloy systems in which vacancy jump frequencies are available from isotope diffusion experiments, the impurity segregation generated by vacancy currents around growing voids can be calculated. (auth)

45989 (CONF-710601–, pp 647-62) ANNEALING OF LOOPS AND TETRAHEDRA. Washburn, Jack (California Univ., Berkeley. Lawrence Berkeley Lab.). Apr 1972.

From International conference on radiation-induced voids in metals; Albany, N. Y. (9 Jun 1971).

A discussion of the mechanisms for annealing of dislocation loops and tetrahedra is presented. The growth of vacancy defects in metals is reviewed with emphasis on vacancy supersaturation. The role of dislocation climb in the shrinkage of loops and tetrahedra is discussed together with the effect of stacking-fault energy. Dislocation-loop migration by diffusion along the dislocation core is shown to be a possible mechanism for coarsening of small dislocation loops at temperatures just below that required for ordinary self-diffusion. (auth)

45990 (CONF-720806-2) ANALYTICAL APPLICATIONS OF THE J INTEGRAL. Merkle, J. G. (Oak Ridge National Lab., Tenn.). 1972. 29p. Dep. NTIS.

From sixth national symposium on fracture mechanics; Philadelphia, PA. (28 Aug 1972).

It has recently been shown by experiment that a quantity known as the J Integral may be a useful fracture criterion in the inelastic range. The mathematical definition of the J Integral is used to derive a relationship between the conventional elastic stress concentration factor of a sharp notch and the elastic stress intensity factor for a crack of the same shape. This relationship has previously been derived only by assuming some particular shape of cracked body, but this assumption is shown to be not necessary. The same assumptions, together with Neuber's equation for the inelastic stress and strain concentration factors for a sharp notch, are used to derive a relationship between the J Integral and the parameter K_{Icd} of the Equivalent Energy Method. A graphical procedure for estimating upper and lower bounds on the full restraint value of the fracture toughness is also discussed. (auth)

45991 (COO-916-25) STRUCTURE AND PROPERTIES OF SOLID SOLUTIONS. Technical Progress Report, September 1, 1971–June 15, 1972. Hendrickson, A. A.; Koss, D. A. (Michigan Technological Univ., Houghton. Dept. of Metallurgical Engineering). 1972. Contract AT(11-1)-916. 27p. Dep. NTIS.

Results of studies on bcc solid solution hardening in high-purity Nb–Hf, Nb–W, and Nb–Ta alloys are presented. Data from measurements of a thermal yield stress in substitutional Nb–W–Mo alloys deformed at 900°K are included. Results of fcc solid solution hardening studies are also presented which indicate that serrated yielding occurred in single crystals of Ag-base-In alloys. (J.R.D.)

45992 (LBL-659) SOME PROPERTIES OF PROTACTINIUM METAL AND ITS COMPOUNDS. Dod, Raymond Lloyd (California Univ., Berkeley. Lawrence Berkeley Lab.). May 1972. Contract W-7405-eng-48. 98p. Dep. NTIS.

Thesis.

A modification of the usual metallothermic method of metal production is described, utilizing a molten salt crucible which substantially reduces the probability of contaminating the protactinium metal with crucible material. The method may have general applicability to the preparation of small quantities of high melting point metals. A redetermination of the magnetic susceptibility of protactinium metal was made, resulting in a substantial change in value although not in temperature dependence from that previously reported. The new value is $(190 \pm 5) \times 10^{-6}$ cgs units/mole and is independent of temperature from ~7°K to 300°K. This value holds for both the normal tetragonal form of the metal and also the fcc high temperature modification. The magnetic susceptibility of PaF_4 is also reported. The observed behavior can be interpreted to follow the Curie–Weiss law with an effective moment of 1.81 Bohr magnetons and a Weiss constant of 22.5°. The reactions of protactinium metal with several common gases at temperatures up to 700° are described. Standard x-ray powder diffraction techniques were used to analyze the results. New compounds reported include two nitrides prepared by reaction of the metal with nitrogen and with ammonia. Both exhibited a cubic fluorite type lattice. The observed lattice parameters were $a_0 = 5.436 \pm 6$ Å and $a_0 = 5.395 \pm 3$ Å. A new hydride structure for PaH_3 was observed, isomorphic with α-uranium hydride with $a_0 = 4.152 \pm 2$ Å. Additionally, an unidentified phase was observed in reaction of hydrogen with Pa metal at 400°C, which was presumed to be a hydride since thermal decomposition regenerated the metal. The hydride previously reported for protactinium was not observed, nor was any evidence for the existence of the reported monoxide, PaO, seen in any reaction, including those with air, oxygen, and water. The melting point and thermal expansion coefficients for a high purity sample of the metal have shown that the previous values, derived from samples of dubious quality, were more accurate than had been thought. (auth)

45993 (ORNL-tr-2377) BRITTLE-DUCTILE TRANSITION OF BODY-CENTERED CUBIC METALS WITH SPECIAL CONSIDERATION OF TUNGSTEN AND MOLYBDENUM. PART I. EXPERIMENTAL METHODS. Pink, E.; Sedlatschek, K. Translated for Oak Ridge National Lab., Tenn., from Metall; 23: No. 12, 1249-57(1969). 22p. Dep. NTIS.

The most advantageous method to determine the brittle-ductile transition of tungsten and molybdenum sheets consists of the bending test conducted at different temperatures. The results changed when important dimensions of the equipment were varied. The sharpest indication of the transition was possible with the smallest possible gage length. The ratio of punch radius to specimen thickness i.e., the so-called T-value, was important to the transition temperature. The experiences collected led to suggestions for standardization of the method. The transition temperatures for work-hardened rolled molybdenum and tungsten were – 80 to – 70°C and 100 to 200°C, respectively, and for the recrystallized metals to 20 to 100°C or about 360°C, respectively. Recrystallized molybdenum and tungsten with a distinct stacked structure were still ductile at room temperature. The variation of the transition temperature of the system molybdenum–tungsten was not linear. The substitution effect produced an increase in the transition temperature in the recrystallized state and a decrease in the work-hardened metal. In work-hardened dispersions of Mo–Al_2O_3 the transition temperature decreased. An embrittling effect was produced only by larger amounts of dispersate (>1 vol%). (P.C.H.)

45994 (UCLA-34-P-177-10) REACTOR STEELS STUDIES. Quarterly Progress Report, October–December 1971. Ono, K.; Tetelman, A. S.; Ardell, A. J. (California Univ., Los Angeles. School of Engineering and Applied Science). Mar 1972. Contract AT(04-3)-34. 13p. Dep. NTIS.

Research progress is reported on structure and strengthening of 2.25 Cr–1 Mo steels, effects of microstructure on fracture modes of Types 304 and 316 stainless steels, and precipitation reactions in stainless steels. (J.R.D.)

45995 (UJV-2802-M) MECHANICAL CHARACTERISTICS OF URANIUM ALLOYS OF THE TYPE U–Mo(Fe, Al, Si) AND U–Fe–Al–(Si, Cr). Saxl, I. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). 1972. 46p. (In Czech). Dep. NTIS (U. S. Sales Only).

The mechanical properties of uranium alloys containing low additions of Al, Fe, Mo, Si, and Cr were measured in the temperature interval 20 to 640°C. The mutual correspondence between phenomenological quantities (strain rate sensitivity m and logarithmic hardening at the maximum load n_{Pt}) and ductility parameters (inhomogeneous elongation ϵ_n and homogeneous elongation ϵ_{Pt} was confirmed. Above 200°C, the relations $\epsilon_{Pt} = n_{Pt}$ and $\epsilon_n = f(m)$ were held independently of the experimental conditions (e.g., temperature, deformation rate, and composition). Below 200°C, both the relations were disturbed by the embrittling phenomena connected with the presence of the nonmetallic inclusions. The temperature dependence of the total elongation (with its characteristic intermediate temperature minimum) was the direct consequence of the temperature dependences of hardening and strain rate sensitivity parameters. The amount of alloy hardening and its temperature characteristics are discussed on the basis of recent dispersion hardening theories. (auth)

45996 (WCAP-7841) DISCUSSION ON FRACTURE MECHANICS CONCEPTS. Mager, T. R.; Buchalet, C.; Enrietto, J. F. (Westinghouse Electric Corp., Pittsburgh, Pa.). Mar 1972. 24p. Dep. NTIS.

Results of brief review of four fracture mechanics concepts applicable for developing a fracture prevention criterion for heavy-section nuclear reactor pressure vessels are presented. It is concluded that linear-elastic fracture mechanics technology (L.E.F.M.) is applicable to heavy-section components, such as nuclear reactor vessels, when plane strain conditions prevail and the plastic zone remains small. The two basic assumptions and the technical consequences of the stress concentration theory (SCT) were examined with reference to heavy sections. It was found that the SCT cannot be applied to heavy-section steel vessels. The crack opening displacement (COD) approach is compatible with both linear-elastic fracture mechanics and transition concepts. The path independent J-integral apparently can be used to predict fracture in low- to high-strength steels for conditions ranging from linear-elastic to fully plastic. However, the concept has not been fully developed to date, thus practical application appears to be several years away. (J.R.D.)

45997 CONSTITUTION OF BINARY ALLOYS, SECOND SUPPLEMENT. Shunk, Francis A. McGraw-Hill Series in Materials Science and Engineering. New York, McGraw-Hill Book Company (1969). 759p. $37.50.

Systems are arranged in alphabetical order of the chemical symbols of the elements. For each system, the existence of a review in Hansen, Elliott, or this Supplement is indicated by the appropriate page number, and the inclusion of a diagram is also indicated. Other references pertinent to the systems are also given. (P.C.H.)

45998 THERMAL PROPERTIES OF LIQUID CERIUM. Mardykin, I. P.; Vertman, A. A. Izv. Akad. Nauk SSSR, Metal.; No. 1, 95-8(1972). (In Russian).

The properties of liquid cerium were studied in an apparatus designed for the simultaneous measurement of thermal conductivity and heat capacity at high temperatures. The results indicated that the heat conductivity and thermal capacity of liquid Ce were only weakly dependent on the temperature over the temperature range 1,100 to 1,600°K. (K.S.W.)

45999 EFFECT OF MICRO-ADDITIVES OF RARE EARTH METALS ON THE GRAIN BOUNDARY ENERGY OF NICKEL. Koval, A. D.; Ol'shanetskii, V. E. Izv. Akad. Nauk SSSR, Metal.; No. 1, 124-32(1972). (In Russian).

The effects of adding small amounts of Nd, Pr, Ce, and La on the grain boundary energy and on the migration of the boundary of pure nickel was studied. Such additives were disposed chiefly on the grain boundary, changing the value of its excess free energy. The concentration dependence of the grain boundary energy of 99.9999% pure Ni was a curve with a maximum at 0.5×10^{-3} atom fraction of rare earths. The velocity of migration of a grain boundary at some particular rare earth metal content was associated with both additive interaction and the formation of chemical compounds with "unaccounted-for metals" (with the refining of the grain boundary). The four metals affected the grain boundary energy and the velocity of boundary migration in the following order (greatest effect last): La, Ce, Pr, Nd. (K.S.W.)

46000 CREEP OF NIOBIUM UNDER CONDITIONS OF INLEAKAGE OF OXYGEN. Abramyan, E. A.; Ivanov, L. I.; Kazilin, E. E. Izv. Akad. Nauk SSSR, Metal.; No. 1, 177-82(1972). (In Russian).

The effects of a current of oxygen at an intensity of 5×10^{17} mole/sec on creep of niobium during twisting were investigated over the temperature range 1,200 to 1,850°C and under a stress of 6 to 200 kg/cm^2. A sharp increase in the creep rate occurred simultaneously with contact with the oxygen stream, this phenomenon being temperature-dependent. Several reasons for the sudden increase in creep rate are discussed. (K.S.W.)

46001 THERMODYNAMIC PROPERTIES AND PHASE COMPOSITION OF La–Zn ALLOYS. Kovalevskii, A. V.; Lebedev, V. A.; Nichkov, I. F.; Raspopin, S. P. Izv. Akad. Nauk SSSR, Metal.; No. 1, 183-7(1972). (In Russian).

The La–Zn equilibrium diagram was investigated with the aid of emf measurements over the range 723 to 1,123°C using a galvanic cell of the type La–Zn/LiCl–KCl + 2 wt % $LaCl_3$/La–$Zn_{sat.\,soln.}$. The existence of the following eight metallic compounds was established: $LaZn_{11}$, $LaZn_9$, $LaZn_8$, $LaZn_7$, $LaZn_6$, $LaZn_4$, $LaZn_2$, and LaZn. Thermodynamic properties of the alloys attested to the energy of interaction between La and Zn. (K.S.W.)

46002 REACTION OF Nb-Mo ALLOYS WITH BORON. Zhunkovskii, G. L.; Braun, S. M. Izv. Akad. Nauk SSSR, Metal.; No. 1, 188-92(1972). (In Russian).

A study of the reactions of B with Nb–Mo alloys indicated that the reaction rate was determined by the percent of a component in the alloys. Over the range 1,100 to 1,400°C the rate of increase of the boride phase in alloys with 20 to 50% of Mo was four to six times less than pure Nb and Mo. The prospects of using this type of alloy in boron-containing media are discussed. (K.S.W.)

46003 SURFACES OF THE SOLIDUS AND THE LIQUIDUS IN THE SYSTEM Th–Zr–U. Badaeva, T. A.; Kuznetsova, R. I. Izv. Akad. Nauk SSSR, Metal.; No. 1, 196-200(1972). (In Russian).

The isothermal surfaces of the solidus and liquidus of the ternary system Th–Zr–U were constructed from data from thermal analysis, differential heating curves, and the microstructure of these alloys. The results were found to agree with previous work. Solidus and liquid curves in the binary systems Th–U and Th–Zr from 20 to 70 at. % U were established with greater precision than before. For the compositions studied the temperature of the solidus ranged from 1,070 to 1,485°C; that of the liquidus from 1,260 to 1,855°C. (K.S.W.)

46004 THERMODYNAMIC PROPERTIES OF SOLUTIONS IN THE SYSTEM In–Sn–Hg. Nigmetova, R. Sh.; Sudakov, V. A.; Kosin, L. F. Izv. Akad. Nauk SSSR, Metal.; No. 1, 201-7(1972). (In Russian).

Pressure measurements of Hg vapor from In–Sn–Hg alloys in the temperature interval 150 to 340°C were used to calculate thermodynamic functions of amalgams in this ternary system. Calculated values for the activity of Hg in this system were in good agreement with experimental values. Significant negative and small positive deviations of thermodynamic quantities from those expected for ideal solutions were realized. (K.S.W.)

46005 TERNARY SYSTEM Y–Fe–Al IN THE REGION 0 TO 33.3 PERCENT Y. Zarechnyuk, O. S.; Rykhal, R. M.; Ryabov, V. P.; Vivchar, O. I. Izv. Akad. Nauk SSSR, Metal.; No. 1, 208-10(1972). (In Russian).

Ninety ternary alloys of the system Y–Fe–Al up to a Y content of 33.3% were investigated with x-ray structural analysis, and an isothermal section was constructed at 500°C. Compounds and phases identified were: a compound $YFe_{4.0-5.8}Al_{8.0-8.2}$, a compound $YFe_{1.0-1.2}Al_{1.0-0.8}$, a compound YFe_2Al_{10}, a phase $\lambda_{2(Fe)}$ (a solid solution of Al in YFe_2), a phase $\lambda_{2(Al)}$ (a solid solution of Fe in YAl_2), a phase ϕ_1 (a solid solution of Al in Y_2Fe_{17}), and a phase ϕ_2 (a solid solution of Al in Y_2Fe_{17}, with a structure different from ϕ_1). (K.S.W.)

46006 EFFECT OF MOLYBDENUM ON AGING OF Fe–Co–W ALLOYS. Ershova, L. S. Izv. Akad. Nauk SSSR, Metal.; No. 1, 211-15(1972). (In Russian).

The alloying of Fe–Co–W alloys with Mo lead to an increase in the micro-deformation of the crystal lattice of the quenched α-solid solution. A comparison of the aging kinetics in alloys V16K23 (15.52% W, 23.52% Co) and V16M8K23 (16.05% W, 22.50% Co) showed that the addition of Mo significantly raised the rate of dispersed solidification. The effects of Mo on structural changes during aging are explained by a change in the composition of the quenched solid solution and an increase in the imperfection of the crystalline lattice. (K.S.W.)

46007 CALORIMETRIC STUDY OF Nb–Fe–Si–Al SYSTEM. Gorelkin, O. S.; Dubrovin, A. S. Izv. Akad. Nauk SSSR, Metal.; No. 1, 216-21(1972). (In Russian).

The heats of solution of Al and Si in Fe, and of Nb in Nb–Fe alloys were determined with a large capacity isothermal calorimeter. The necessity for making allowance for the heat of solution of elements in estimating thermal balances in niobium alloys was demonstrated. (K.S.W.)

46008 STUDIES OF THE ORIGIN OF THE EXOGENOUS OXIDE INCLUSIONS IN KILLED AND UNKILLED CAST STEELS THROUGH SUBSEQUENTLY ACTIVATED TRACER ELEMENTS. Benkoe, Gyulane; Simon, Sandor; Szarka, Gyula. Neue Huette; 17: No. 1, 40-3(Jan 1972). (In German).

Oxide inclusions in steel originating from heat-resistant material were studied. Barium-140, in the form of $BaCl_2$, was applied to the heat-resistant cladding of the casting vessel and various other parts of the casting equipment. By electrolysis, inclusions were then separated from the steel and their activity measured using a Geiger–Mueller counter. Results showed that inclusions originated mainly from those sections of the heat-resistant material that were mechanically stressed during the casting process. In an alternate method, stable barium was applied to the heat-resistant cladding. After isolation of the steel inclusions by electrolysis, they were activated with 14-MeV neutrons and the γ spectrum was obtained using a crystal detector and a multichannel analyzer. (H.B.G.)

46009 EFFECT OF MECHANICAL SURFACE HARDENING ON THE LOW-CYCLE FATIGUE STRENGTH OF TITANIUM ALLOYS. Kudryavtsev, I. V.; Vainshtein, V. G. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 13: No. 11-12, 1038-40(1971).

Translated from Metalloved. Term. Obrab. Metal.; 13: No. 12, 44-6(Dec 1971).

Surface hardening effectively increased the low-cycle fatigue strength of titanium alloy VT3-1 particularly with stress concentrators. Hardening a notch by burnishing substantially increased the fatigue limit under load to a value corresponding to the yield strength of the material and could completely eliminate the unfavorable effect of the concentrator. Hardening of the area near the stress concentrator without hardening the notch itself had comparatively little effect. (auth)

46010 FORMATION OF INTERMETALLIC PHASES IN THE SYSTEM Ir–Ta–Ni. Bernard, V. B.; Kuprina, V. V.; Burnashova, V. V. Vestn. Mosk. Univ., Ser. II. Khim.; 13: No. 2, 240-1 (1972). (In Russian).

The system Ir–Ta–Ni was investigated over a full range of concentrations. New intermetallic phases denoted as X, Y, A were observed. (auth)

46011 STUDY OF ZIRCONIUM EVAPORATION FROM OPEN SURFACE. Golubtsov, I. V.; Mikul'skaya, G. Yu.; Pavlova, L. M. Vestn. Mosk. Univ., Ser. II. Khim.; 13: No. 2, 206-10 (1972). (In Russian).

A new apparatus was built for studying the evaporation of construction materials in vacuum at high temperature. The evaporation rate of β-zirconium was measured. (auth)

46012 SINTERED MAGNESIUM COMPOSITES, CLADDING MATERIAL OF URANIUM FUEL ELEMENTS COOLED BY CARBON DIOXIDE. PART II. ANISOTROPY OF PROPERTIES OF EXTRUDED AND RECRYSTALLIZED PRODUCTS. Volf, Frantisek; Sokol, Ludvik; Cech, Bohuslav (Nuclear Research Inst., Rez, Czech.). Jad. Energ.; 18: No. 5, 151-7(May 1972). (In Czech).

Discussion is presented on the anisotropy of properties of sintered magnesium products, especially of extruded and recrystallized rods and tubes. The effect of processing conditions on the formation of preferred orientation has been investigated. The preferred orientation of the magnesium hexagonal unit cell in green compacts of magnesium powder is parallel to the axis of compacting, whereas in extruded and recrystallized products it is almost perpendicular to the extrusion axis. (auth)

46013 EXPLOITATION OF SOLID ELECTROLYTES IN RESEARCH AND TECHNOLOGY OF NUCLEAR POWER. Jakes, Dusan (Nuclear Research Inst., Rez, Czech.). Jad. Energ.; 18: No. 5, 158-63(May 1972). (In Czech).

Methods of application are explained on the basis of indispensable theoretical inferences. Experimental conditions are outlined for investigating the thermodynamics of solid bodies, making solubility measurements, and determining the diffusion coefficients in various materials used in nuclear technology. Solid electrolytes such as ZrO_2–CaO, ZrO_2–Y_2O_3, ZrO_2–MgO, La_2O_3–CaO, and CaF_2–YF_3 have been used with oxygen at different pressures as the anode and cathode, respectively. The use of electrolytes as analytical detecting elements is discussed. (tr-auth)

46014 PHYSICOCHEMICAL MEASUREMENTS IN METALS RESEARCH. PART 1. Rapp, R. A. (ed.). Techniques of Metals Research. Volume IV. New York; John Wiley and Sons, Inc. (1970). 575p.

Information on physicochemical measurements on metals is included under the chapters: physicochemical measurements in metals research; vapor pressure methods, including measurement of the gross equilibrium vaporization rate, free vaporization measurements (Langmuir technique), measurement of vapor pressures by transpiration, isopiestic, and other techniques, and mass spectrometry in the measurement of vapor pressure; calorimetry, including reaction calorimetry and bomb calorimetry; chemical equilibria, including the absorption of unary gases by condensed phases, equilibria and transport phenomena involving gas mixtures and condensed phases, and equilibria and transport phenomena between solid and liquid phases and between two liquid phases; and phase equilibria and transformations, including phase equilibria in metallic systems and techniques for investigating phase-transition kinetics in metals. Vapor pressure data for the solid and liquid elements are appended. (P.C.H.)

46015 PHYSICOCHEMICAL MEASUREMENTS IN METALS RESEARCH. PART 2. Rapp, R. A. (ed.). Techniques of Metals Research. Volume IV. New York; John Wiley and Sons, Inc. (1970). 718p.

Information on physicochemical measurements on metals is included under the chapters: electrochemical measurements, including aqueous electrolyte cells, molten salt electrolyte cells, and solid electrolyte galvanic cells; viscometry and densitometry, including viscosity of liquid metals and liquid density measurements; surface energy measurements, including measurement of liquid-vapor and solid-vapor surface energies and interfacial energies between condensed phases; diffusion measurements, including volume diffusion in solids, surface, grain boundary, and dislocation pipe diffusion, and diffusion measurements in liquid metals; and oxidation and corrosion, including oxidation of metals and corrosion of metals. (P.C.H.)

46016 X-RAY AND NEUTRON DIFFRACTION STUDY OF THE HOLMIUM–IRON SYSTEM. Simmons, Michael Fred. Rolla, Mo.; Univ. of Missouri (1971). 74p. University Microfilms Order No. 72-18,205.

Thesis.

Neutron diffraction and x-ray powder studies have been made of holmium-iron intermetallic compounds. The magnetic moments of Ho and Fe are in good agreement with measured spontaneous magnetization assuming a ferrimagnetic model with the Ho moments antiparallel to the Fe moments. The magnetic moments of the Fe atoms are found to be localized and thus independent of the rare earth content in the alloys. In contrast to $HoCo_3$, (001) type magnetic peaks in the neutron diffraction patterns are still prevalent at room temperature and gradually decrease as the Curie temperature is approached. This fact indicates that the easy direction of magnetization remains in the basal plane. The easy direction of magnetization at room temperature is found to be parallel with the cube edge in $HoFe_2$ and to lie in the basal plane in $HoFe_3$ and Ho_2Fe_{17}. The easy direction is parallel to the a-axis in Ho_2Fe_{17}. It is parallel to the b-direction, i.e., 30° from an a-axis, in the $HoFe_3$ hexagonal cell. (Diss. Abstr. Int., B)

46017 GENESIS OF CELLULAR PRECIPITATION IN COPPER RICH COPPER–INDIUM ALLOYS. Fournelle, Raymond Albert. Rolla, Mo.; Univ. of Missouri (1971). 148p. University Microfilms Order No. 72-18,190.

Thesis.

The morphology of cellular precipitation in a Cu-9.5 at. %In alloy has been investigated by light and electron microscopy and x-ray and electron diffraction. Both cellular and general precipitation were observed to occur simultaneously in quenched and aged alloys while only cellular precipitation was observed to occur in isothermally aged alloys. Because of the presence of wide, vacancy depleted precipitate free zones in the vicinity of grain boundaries, general precipitation was observed to have no effect on the early development of cellular precipitation. Hence, the early development of cellular precipitation was found to be identical for both types of heat treatment. By light and electron microscopy of the early stages of precipitation a mechanism for the development of cells from an initially unoccupied grain boundary was developed. According to this mechanism the grain boundary allotriomorphs begin to form, the boundary interacts with them by bowing out between them and trailing precipitate behind to eventually develop a steady state cellular structure. Assuming that the critical step in the development of a cell is the ability of the boundary to bow between initial allotriomorphs, a criterion for the occurrence of cellular precipitation was developed. (Diss. Abstr. Int., B)

46018 PHASE DIAGRAM OF THE NIOBIUM–GALLIUM SYSTEM. Pan, V. M.; Latysheva, V. I. (Inst. of Metal Physics, Kiev). Metallofizika; No. 38, 95-100(1971). (In Russian).

The phase equilibrium diagram of the Nb–Ga system was constructed from data from differential thermal analysis, tempered microstructure, and x ray analysis. A rather wide region of solid solutions (up to 20 atom % Ga at 1750°C) was discovered. Six compounds existed at room temperature: Nb_3Ga, Nb_5Ga_3, Nb_5Ga_4, Nb_4Ga_5, Nb_5Ga_{13}, and $NbGa_3$. The single compound $NbGa_4$ existed at high temperatures and in a narrow temperature interval. For each of the compounds the temperature and character of formation were determined. The critical temperature of the superconducting compound Nb_3Ga, annealed at 800°C for 10 h, at half-transition was 16°K. (tr-auth)

46019 PECULIARITIES IN THE STRUCTURAL SENSITIVITY AND MECHANICAL CHARACTERISTICS OF NIOBIUM. Mil'man, Y. V.; Udovenko, A. A. (Inst. of Metal Physics, Kiev). Metallofizika; No. 35, 34-49(1971). (In Russian).

A survey was made of the literature on the structure, substructure, and mechanical characteristics of Nb and its alloys, and of the factors that affect them, such as plastic deformation and heat treatment. The influence of grain dimensions, crystal dislocations, and annealing processes are also discussed. (58 references). (K.S.W.)

46020 SEPARATION PROCESSES IN SUPERCONDUCTING ALLOYS OF NIOBIUM–ALUMINUM. Ganzhula, N. N.; Patysheva, V. I.; Pan, V. M.; Chuistov, K. V. (Inst. of Metal Physics, Kiev). Metallofizika; No. 36, 107-11(1971). (In Russian).

X-ray studies were made on polycrystalline samples and micro single crystals of transformation processes occurring during heating of quenched alloy Nb–18% Al. Before transformation of a second phase (Nb_3Al) in the narrow temperature interval 750 to 800°C, there occurred ordering of the original solid phase with the formation of a crystal of the CsCl type. Breakdown of the Nb–Al alloy quenched from 1750°C was noticed after heating at 800°C (1 h), and was accompanied by significant hardening. Maximum hardness was achieved after aging for 1 h at 1200°C. During disintegration the intermetallic phase Nb_3Al separated out, with a composition essentially depleted of Al in comparison with the stoichiometric. In an alloy with 15% Al after 70% deformation and annealing at 900°C for 10 h, a diffused transition to the superconducting state began at 14°K, and the critical current density at 4.2°K depended on the magnetic field. (tr-auth)

46021 VARIATIONS IN THE CRITICAL TEMPERATURE OF THE SUPERCONDUCTING COMPOUNDS Nb_3Al AND $Nb_3Al_xGe_{1-x}$. Pan, V. M.; Latysheva, V. I.; Sudovtsov, A. I. (Inst. of Metal Physics, Kiev). Metallofizika; No. 36, 104-7(1971). (In Russian).

The dependence of the critical temperature T_c of the superconducting compounds Nb_3Al and $Nb_3Al_xGe_{1-x}$ on the composition and previous thermal history was investigated. Changes in T_c were contrasted with data on the location of phase boundaries of stability regions of these compounds and data on changes in the density of electron states. The latter were found by electron-positron annihilation. An increase in T_c in the compound Nb_3Al during an elevation on the concentration of Al was associated with a growth in the density of electron states. The highest T_c was obtained in non-equilibrium alloys in which high Al and Ge contents were fixed by rapid cooling. At low-temperature (700 to 750°C) annealing, approaches to an equilibrated composition depleted of Al and Ge did not occur through aging, but the degree of long-range order of atoms increased. (tr-auth)

46022 ORIENTATION DEPENDENCE OF DAMPING OF ELASTIC VIBRATIONS IN TUNGSTEN SINGLE CRYSTALS. Benieva, T. Ya.; Golub, T. V. (Inst. of Metal Physics, Kiev). Metallofizika; No. 36, 90-4(1971). (In Russian).

The amplitude dependence of internal friction in single crystals of tungsten was determined over the temperature range 100 to 700°C by a method of damping of free bending movement of the crystals. Tungsten crystals with orientations of [100], [110], and [111] exhibited considerable damping, pronounced amplitude dependence, and an absence of amplitude dependence of internal friction in that region of amplitude deformation observed in special orientation. A critical shearing micro-stress of breaking and its temperature dependence were determined from data on amplitude-dependent internal friction. The smallest value for the critical micro-stress was observed for a W crystal with the orientation [100]; and the greatest value with the orientation [111]. Such behavior for crystals with three orientations apparently stems from anisotropic mobility of boundary dislocations in the W lattice. (tr-auth)

46023 DETERMINATION OF THE ENERGY OF DISLOCATION OF AN IMPURITY ATOM BY AN INTERNAL FRICTION METHOD. Benieva, T. Ya.; Polotskii, I. G.; Skopin, V. S. (Inst. of Metal Physics, Kiev). Metallofizika; No. 36, 86-90(1971). (In Russian).

The energy of dislocation of a foreign atom in solid solutions of Cu–Mg, Mo, and W was determined from experimental data on the amplitude dependence of internal energy. The results of the computation were compared with the energy of interaction in Cu–Mg solid solutions from other methods of calculation. (tr-auth)

46024 COMMENTS ON DIFFUSION OF COBALT IN PLUTONIUM BY M. J. DAPTH, M. P. DARIEL AND A. ROSEN IN SCRIPTA MET., 5, 191-194(1971). Million, B.; Kucera, J. (Inst. of Physical Metallurgy, Brno). Scr. Met.; 6: No. 7, 617-19(Jul 1972).

Comments are given on a previous study on the Co hetero-diffusion in the fcc δ-phase and in the bcc ϵ-phase in Pu with the use of the serial sectioning method. Use of the least squares method applied to 363°C data given previously led to the value $D = 1.96 \times 10^{-11}$ cm²/sec for the volume hetero-diffusion coefficient, to the value $D_1 = 5 \times 10^{-8}$ cm²/sec for the grain boundary diffusion with the grain width $2a = 6 \times 10^{-4}$ cm and to the effective grain size $b = 0.026$ cm. Comparing this Co volume hetero-diffusion coefficient with the Pu self-diffusion coefficient at the same temperature $D = 2.86 \times 10^{-11}$ cm²/sec, it was found that these values are rather close to each other, their portion being 1.46. Thus Pu appears to be different from other polyvalent metals, as Co does not diffuse in Pu with significantly higher diffusion coefficients than is the case for Pu self-diffusion. It was concluded that there is not an especially strong vacancy—cobalt atom impurity bonding in δ-Pu. (P.C.H.)

46025 VACANCY DEFECTS IN QUENCHED VANADIUM. Boostrom, D. R.; Chen, C. W. (Iowa State Univ., Ames). Scr. Met.; 6: No. 7, 571-8(Jul 1972).

Transmission electron microscopy (TEM) was used to examine V foils after quenching and annealing. Use of the Kuhlmann-Schultz method (using superfluid properties of liquid helium(II)) for quenching high-purity V produced defects only when the quenched foils were annealed between 300 and 500°C. The defects were probably complexes of vacancies and interstitial impurity atoms, presumably of oxygen. No evidence was found to indicate the possibility of quenching vacancies into V under the conditions of the quenching technique used and at the present impurity level. The results thus reconfirmed the predictions of others in regard to the effective trapping of vacancies by interstitial impurity atoms in bcc transition metals during quenching. (P.C.H.)

46026 THERMODYNAMIC PROPERTIES OF THE PHASE In_5Bi_3. Singh, H. P.; Rao, M. H.; Misra, S. (Banaras Hindu Univ., India). Scr. Met.; 6: No. 7, 621-6(Jul 1972).

The heats of formation and fusion of the equilibrium phase, In_5Bi_3, were determined calorimetrically. The free energy of formation and the excess free energy of the corresponding liquid alloy were also calculated. Data are tabulated. (P.C.H.)

46027 FREE VOLUME AS A GUIDE TO GRAIN BOUNDARY PHENOMENA. Aaron, H. B.; Bolling, G. F. (Ford Motor Co., Dearborn, Mich.). Scr. Met.; 6: No. 7, 553-62(Jul 1972).

It is suggested that the entire class of properties associated with the presence of static grain boundaries can be rationalized primarily in terms of the amount of free volume without need for a detailed model of the grain boundary structure. A second class of properties associated with the presence of moving boundaries requires knowledge of the distribution of free volume and thus a model for their rationalization. Also, free volume is related to diffusion, and the contribution of free volume to the activation enthalpy for diffusion is quantitatively developed. Two examples are given that suggest how the concept of a free volume and a measure of its amount might be used without need for a detailed model of the boundary. (20 references) (P.C.H.)

46028 TEMPERATURE DEPENDENCE OF THE FRICTION STRESS FOR BASAL DISLOCATIONS IN BERYLLIUM IN THE RANGE 300 TO 500°K. Turner, G. I.; White, J. S. (Atomic Weapons Research Establishment, Aldermaston, Eng.). Acta Met.; 20: No. 8, 997-1000(Aug 1972).

The temperature dependence of the friction stress for basal dislocations in beryllium has been measured in the range 300 to 500°K. The friction stress values were evaluated from the analysis of closed mechanical hysteresis loops developed by the cyclic compression of single crystals. The results showed that the friction stress for this system decreases in an almost linear fashion with increasing temperature from 0.038 kg mm^{-2} at 300°K to 0.018 kg mm^{-2} at 500°K. For each temperature investigated, the maximum loop width and the corresponding irreversible work data obtained from the family of closed hysteresis loops were fitted to a power law of the type $W = A\epsilon_{MLW}^{N}$, where W = the irreversible work done in forming a loop, ϵ_{MLW} = the maximum loop width in microstrain and A and N are constants. The friction stress, $dW/d\epsilon_{MLW}$, was then determined using the power law relationship at ϵ_{MLW} = one microstrain and also from the alternative method involving the use of the elastic limit as obtained by extrapolation of the maximum shear stress versus the maximum loop width curve to zero loop width. Both methods of analysis gave essentially the same values. The significance of the results in terms of the influence of basal slip on the fracture of beryllium is discussed. (auth)

46029 CONTRAST PATTERNS PRODUCED BY SELF-INTERSTITIAL ATOMS IN FIELD ION MICROSCOPE IMAGES OF A B.C.C. METAL. Seidman, D. N.; Lie, K. H. (Cornell Univ., Ithaca, N. Y.). Acta Met.; 20: No. 8, 1045-59(Aug 1972).

A general method is presented for calculating the contrast pattern to be expected from a single self-interstitial atom (SIA) in a field ion microscope (FIM) image. It was assumed that the SIA was embedded inside a FIM spectrum well below the surface. The SIA was uncovered and eventually removed by the field evaporation of successive atomic planes. Atoms on the surface were displayed outwards from the surface as a result of the dilatational field of the SIA. This outward displacement of atoms resulted in 3 possible contrast effects. These 3 contrast effects were: a bright spot; an extra bright spot; and a vacant lattice site. A single SIA atom can produce all these contrast effects and the totality of these effects was termed a contrast pattern. The atom displacements were obtained from the α-iron interatomic potential of Johnson, without allowing for surface relaxation effects. Detailed atomic displacement maps were presented for the {111} planes with a ⟨110⟩ split and a ⟨111⟩ split crowdion SIA configura-

tions located many interplanar spacings underneath these surfaces. It was shown that the resulting atomic displacement maps contained sufficient information to allow the configuration of the SIA to be determined. An atom displaced normal to a surface plane by a SIA was represented by an electric dipole whose strength was a function of the magnitude of the displacement. A local field enhancement factor was then calculated (the possibility of charge redistribution was allowed for in the enhancement factor) and converted to an extra ion current via the Chen–Seidman data on the ion current vs electric field characteristic curves of individual planes. An application of the above principles was presented for a SIA contrast pattern detected in a (111) plane of tungsten irradiated with 20 keV W^+ ions at 18°K (Scanlan et al.). This contrast pattern contained the three contrast effects suggested by the model. (auth)

46030 INITIAL REACTION OF NITROGEN WITH ZIRCONIUM AT 1440°. Sallach, R. A. (Sandia Labs., Albuquerque, N. Mex.). J. Phys. Chem.; 76: No. 15, 2156-8(20 Jul 1972).

The reactions of nitrogen with zirconium at 1440° and pressures between 2 and 10 mtorr were followed using a microbalance and a radiant-heat furnace. At constant pressure there was an initial linear reaction whose duration was inversely proportional to the square of the pressure and which was followed by a transition to a parabolic regime. The linear portion corresponded to the reaction of nitrogen with a β-Zr surface and continued while the α-Zr phase was formed, ending when the α-Zr surface saturated and a thin ZrN layer formed. In the linear regime the sticking coefficient was independent of gas pressure and had the same value for both the β-Zr and α-Zr surfaces—between 0.05 and 0.08. (auth)

46031 SYSTEM NIOBIUM–ALUMINUM–GERMANIUM, ITS PHASE DIAGRAM, AND SUPERCONDUCTING PROPERTIES. (A REVIEW). Pan, V. M.; Patysheva, V. I. (Inst. of Metal Physics, Kiev). Metallofizika; No. 33, 38-50(1971). (In Russian).

The Nb angle of the phase equilibrium diagram is presented for the ternary system Nb–Al–Ge in the form of isothermal sections at 1,000 to 2,000°C, polythermal sections for various component combinations, and the surface of the liquidus. The existence of two four-phase peritectic equilibria was established: 1,910 and 1,930°C. There was observed in the solid state a series of solid solutions between the isomorphic compounds β–Nb_3Al and β–Nb_3Ge, whereas the stoichiometry of the compound $Nb_3Al_xGe_{1-x}$ was maintained only in the compositions $Nb_3Al_{0.8}Ge_{0.2}$–$Nb_3Al_{0.7}Ge_{0.3}$. Gradual substitution of Al by Ge produced a gradual increase on T_K of the compounds $Nb_3Al_xGe_{1-x}$, but only during the stoichiometry of this composition. For the alloys of the composition $Nb_3Al_{0.75}$–$Nb_3Al_{0.7}Ge_{0.3}$ rapidly cooled without extraction and annealed at 700°C, T_K attained 20.1°K with a transition width of 0.3°K. The increase of T_K for these alloys during low-temperature annealing was associated with regulation, and occurred due to disintegration of metastable compounds of the stoichiometric composition which began at a somewhat higher temperature. (41 references) (tr-auth)

46032 DISINTEGRATION OF SUPERSATURATED SOLID SOLUTIONS ACCORDING TO A HETEROGENEOUS MECHANISM. (A REVIEW). Larikov, L. N.; Shmatko, O. A. (Inst. of Metal Physics, Kiev). Metallofizika; No. 33, 5-37(1971). (In Russian).

The dependence of the changes in a series of properties of aging alloys on the mechanism of separation was examined, and the simultaneous formation and growth of centers of new phases during heterogeneous decomposition were considered. Aging alloys were classified, and those in which decomposition of supersaturated solid solutions occurred based on a heterogeneous mechanism are listed, which includes alloys of W, In, Mo, and Ti. (301 references) (tr-auth)

46033 ALLOYS OF CHROMIUM WITH TERBIUM. Svechnikov, V. N.; Kobzenko, G. F.; Ivanchenko, V. G. (Inst. of Metal Physics, Kiev). Metallofizika; No. 33, 93-5(1971). (In Russian).

The alloys Cr–Tb were investigated by differential thermal analysis, metallography, and hardness testing. An equilibrium phase diagram was constructed over the temperature range 600 to 1,900°C. The results showed that three non-variant transformations may occur, depending on the temperature and composition: $l_1 \rightleftharpoons \alpha_{Cr} + l_2$ at 1,775°C (monotectic); $l(l_2) \rightleftharpoons \alpha_{Cr} + \beta_{Tb}$ at 1,165°C (eutectic); and $\beta_{Tb} \rightleftharpoons \alpha_{Cr} + \alpha_{Tb}$ at 1,045°C (eutectoid). (tr-auth)

46034 SOLUBILITY OF CERIUM, PRASEODYMIUM, AND NEODYMIUM IN CHROMIUM CONTAINING OXYGEN. Kobzenko, G. F.; Kholodov, A. G.; Ivanchenko, V. G.; Martynchuk, E. L.; Kashevskaya, O. N. (Inst of Metal Physics, Kiev). Metallofizika; No. 33, 95-9(1971). (In Russian).

The solubilities of Ce, Pr, and Nd in Cr were investigated by x-ray studies, metallographic, and hardness tests, and curves of solubility were constructed for the temperature interval 1,000 to 1,800°C. The limiting solubility of these rare earth metals in Cr amounted to 1.2 (Ce), 0.9 (Pr), and 1.1 at % (Nd). The influence of each metal present as a solid solution in Cr on the microhardness of the alloy was determined. During alloying of the rare earth metals in Cr which contained oxygen, primary and secondary processes of reduction were evident, brought about by the change in solubility of oxygen and rare earth metal in α_{Cr}. The primary process led to a more complete deoxidation of Cr. (tr-auth)

46035 STRUCTURE, PHASE COMPOSITION, AND PROPERTIES OF CAST COMPLEX ALLOYS OF NICKEL–NIOBIUM. Belinskaya, L. A.; Braun, M. P.; Ionkina, E. M.; Lebedev, K. P.; Khil'chevskaya, T. V. (Inst. of Foundry Problems, Kiev). Metallofizika; No. 33, 102-7(1971). (In Russian).

The structural changes and certain properties of Ni–Nb alloys up to 8% Nb were studied in connection with small additions of W (3%) and Mo (5.1%). Phase compositions were studied after isolating precipitates in specially selected electrolytes. The microstructures were determined on samples in the cast state and after a thermal treatment, which consisted of quenching from 1,200°C and subsequent annealing at 900°C for 16 hours. (tr-auth)

46036 STRUCTURE AND DECOMPOSITION OF Zr AND Ti B.C.C. SOLID SOLUTIONS. Sass, S. L. (Cornell Univ., Ithaca, N. Y.). J. Less-Common Metals; 28: 157-73(1972).

The literature concerning the decomposition of Zr and Ti alloys is reviewed with particular emphasis on the bcc (β) → athermal omega (ω) transformation and the structure of Zr and Ti bcc solid solutions. Illustrative examples were taken principally from the Zr–Nb and Ti–Nb systems. High resolution dark-field electron microscopy, diffraction, and ultrasonic techniques have been used to follow the $\beta \rightarrow \omega$ phase transformation in Zr and Ti alloys. The ω morphology was found to consist of 10 to 15 Å diameter particles arranged in ⟨111⟩ rows. As well, clusters of rows were presented in low solute content alloys and the cluster size decreased with increasing solute content. The observed morphology can explain the presence of {111} planes of diffuse intensity in reciprocal space and the change in appearance of the ω reflections with increasing solute content. The mechanism of the transformation is discussed in terms of instability or metastability of the bcc structure relative to a $\frac{2}{3}$ ⟨111⟩ longitudinal displacement wave. This mechanism can be thought of as involving the ⟨111⟩ displacement of 2 neighboring close-packed rows of atoms relative to each other. Single crystal elastic constant measurements on Zr–Nb alloys showed that C_{44} decreases in the vicinity of the $\beta \rightarrow \omega$ transformation. This is attributed to a softening of the bcc structure which is a precursor to the actual transformation. Alloys that are known to be well above the M_s temperature for the $\beta \rightarrow \omega$ transformation, and hence must be single phase bcc solid solutions, exhibit diffuse ω reflections. It is suggested that the diffuse intensity is due to the presence of a ⟨111⟩ linear fault (or disorder) in the bcc phase. The atom movements associated with this fault are similar to the displacements required for the $\beta \rightarrow \omega$ transformation. (auth)

46037 SOME COMMENTS ON THE BURGERS AND BOGERS: BURGERS TRANSFORMATION MECHANISMS AND THEIR RELATION TO MATHEMATICAL THEORIES OF MARTENSITE CRYSTALLOGRAPHY. Christian, J. W. (Oxford Univ.). J. Less-Common Metals; 28: 67-74(1972).

The relation between single and double shear descriptions of lattice transformations and the current theories of martensite crystallography is discussed in terms of a formalism developed by Acton, Bevis, Crocker, and Ross. The relevance of these theories to nucleation problems is also examined briefly. Particular attention is paid to the bcc → orthorhombic transformations and it was concluded that in certain titanium alloys the lattice deformation is a close approximation to an invariant plane strain. The transformation mechanism may thus be similar to Burgers' original proposal, published in 1934. (auth)

46038 IMAGING PROCESS IN FIELD ION MICROSCOPY. Mueller, Erwin W. (Pennsylvania State Univ., University Park). J. Less-Common Metals; 28: 37-50(1972).

Imaging by field ionization is a complex process. Only recently has the original concept of field desorption led to high resolution self-imaging of a surface. The better established use of field ionization in field-ion microscopy revealed experimental facts which in existing quantum mechanical discussions of the basic process are still quite incompletely understood. Problematic are the sharply localized origin of the ions a few Å away from the metal surface, regional and local brightness features indicating chemical specificity within the bcc, fcc, and hcp lattice groups of the pure metals, and selective imaging of constituents of alloys. A new aspect of the ionization process was introduced with the

discovery, by the atom-probe, of field adsorption of image gas atoms at the apex of the substrate atoms. It is proposed that field ionization probability is greatly enhanced when the electron can tunnel through the intermediate apex-adsorbed atom. This hypothesis is applied to the qualitative explanation of several experimental features. (auth)

46039 ELECTRON MICROSCOPIC INVESTIGATION OF NIOBIUM–OXYGEN ALLOYS WITH ADDITIONS OF ZIRCONIUM AND HAFNIUM. Lobodyuk, V. A.; Loktionov, V. A. (Inst. of Metal Physics, Kiev). Metallofizika; No. 34, 45-9(1971). (In Russian).

Alloys of Nb–O with small additions of Zr and Hf were studied by electron microscopy. Small particles (40 to 120 Å) were observed which were apparently ZrO_2 or HfO_2, and were occasionally formed as dislocations. The amount of material thus separated decreased with a lowering of the oxygen content. (tr-auth)

46040 TENSILE PROPERTIES OF α–ZIRCONIUM. Reed-Hill, Robert E. (Univ. of Florida, Gainesville). Rev. High-Temp. Mater.; 1: No. 2, 97-154(1972).

The mechanical properties of zirconium are considered in terms of tensile test measurements. The tensile properties of metals are widely used for practical design purposes as well as for analyses of the dislocation reactions associated with work hardening and the rate controlling flow-stress mechanism. For this reason emphasis was placed on the fact that the stress-strain behavior can be strongly influenced by a number of factors that have been largely ignored. These include dynamic strain aging as well as dynamic recovery, and in a metal such as zirconium, deformation twinning. It was found that dynamic strain aging tends to make the yield stress temperature (or strain rate) insensitive, to produce anomalous work hardening phenomena, and to cause ductility anomalies such as the "blue brittle" effect. Except for a maximum at elevated temperatures associated with strain aging, the work hardening rate in zirconium as a result of dynamic recovery, decreased continuously with increasing temperature, in a manner analogous to that observed in pure face-centered cubic metals. It was found that twinning is only of significance in zirconium when the specimen texture contains a large fraction of grains with basal planes steeply inclined to the tensile stress axis. A high degree of twinning tends to basically alter the shape of the stress-strain curve. (71 references). (auth)

46041 STRUCTURE OF INTERMEDIATE LAYERS IN DIFFUSION COATINGS. Gabe, D. R. (Univ. of Sheffield, Eng.). Rev. High-Temp. Mater.; 1: No. 2, 155-202(1972).

Factors affecting the structure and constitution of metal diffusion coatings are reviewed with particular emphasis on the coating of iron and steel. Diffusion theory and kinetic data are considered in-so-far as they provide evidence of the intermediate alloyed layers. Emphasis is laid upon the fact that most intermediate layers are non-equilibrium in constitution, and the reasons for this feature are discussed in terms of the thermodynamic factors. (167 references). (auth)

46042 TEXTURES OF ROLLING AND ANNEALING IN TUNGSTEN FOILS OF VARIOUS COMPOSITIONS. Zasimchuk, E. E.; Isaichev, V. I. (Inst. of Metal Physics, Kiev). Metallofizika; No. 34, 62-5(1971). (In Russian).

The predominant orientations in tungsten foils of different compositions were studied by x-ray diffraction after rolling, original recrystallization, and after secondary recrystallization. Orientation of anomalous grains were noted, an increase in these grains being attributed to a decrease in the surface free energy of the system, and occurring at the expense of grains whose crystallographic boundaries coincided with the foil surface and possessed a large surface energy. Impurities may decrease the difference in the surface energies of different boundaries and lead to an increase in the process of secondary recrystallization of certain orientations. (tr-auth)

46043 INFLUENCE OF IMPURITIES AND TEMPERATURE ON THE DEFORMATION OF MOLYBDENUM DURING DYNAMIC LOADING. Benieva, T. Ya.; Golub, T. V. (Inst. of Metal Physics, Kiev). Metallofizika; No. 34, 56-61(1971). (In Russian).

The temperature dependence of critical micro-stress was determined in Mo single crystals of varied purity, using measurements of the amplitude dependence of internal friction by the method of damping of free bending vibrational motion. The critical micro-stress was determined by the magnitude of the deformation at the moment of breaking, and by the value of Young's modulus allowing for the orientation factor. The height of the potential barrier which had been overcome by dislocations during small shifts was established. The critical micro-stress and Young's modulus were measured as a function of temperature up to about 700°K. (tr-auth)

Radiation Effects

Refer also to abstracts: 45702, 46918, 47229, 47231, and 47303.

46044 (AI-AEC-13033) STUDIES OF VOID FORMATION IN PROTON-IRRADIATED TYPE 316 AND TITANIUM-MODIFIED 316 STAINLESS STEELS. Keefer, D. W.; Pard, A. G.; Kramer, D. (Atomics International, Canoga Park, Calif.). 30 Jun 1972. Contract AT(04-3)-824. 31p. Dep. NTIS.

Void formation was studied as a function of helium content in annealed Type 316 stainless steel irradiated with 1-MeV protons at 500°C. Increasing the helium content resulted in an increased void density, with a concurrent decrease in void size. Swelling was unaffected by changes in helium between 0.28 and 28 appM. In a sample containing no helium, the onset of observable voids was delayed to much higher displacement damage. The effect of periodic increases in helium content in a sample irradiated at 500°C was also studied. This procedure altered the void size and density from that observed in singly-injected samples. Below ~20 displacements per atom (dpa), the swelling was also affected. Void formation was studied in annealed Type 316 stainless steel irradiated at 400, 500, and 600°C for amounts of damage up to 50 dpa. The volume increase at each temperature varied exponentially with displacement damage, and the exponent increased with temperature. Volume increases exceeding 20% were associated with 50 dpa at 500°C and 20 dpa at 600°C; no limits on volume increases were apparent at any temperature. Void number density decreased, and average void size increased, with increasing temperature for a constant damage. A titanium-modified Type 316 stainless steel developed a very inhomogeneous void distribution when proton irradiated at 600°C. However, the addition of titanium did not appear to diminish the volume increase at damages between 5 and 10 dpa, when compared to ordinary Type 316 stainless steel. (auth)

46045 (CONF-710601) RADIATION-INDUCED VOIDS IN METALS. Proceedings of the 1971 International Conference Held at Albany, New York, June 9–11, 1971. Corbett, James W. (ed.) (State Univ. of New York, Albany); Ianniello, Louis C. (ed.) (Atomic Energy Commission, Washington, D. C.). Apr 1972. 884p. Dep. NTIS.

A total of 40 papers were presented at the conference. A separate abstract was prepared for each of 23 papers. Sixteen papers were previously abstracted and appeared in NSA as 26: 31556, 26: 5600, 26: 574, 26: 530, 25: 58300, 25: 58299, 25: 58298, 25: 49486, 25: 49482, 25: 48256, 25: 47143, 25: 47142, 25: 47141, 25: 45103, 25: 37982, and 25: 35503. (J.R.D.)

For abstracts of individual papers see: 45987–45989 and 46046–46065.

46046 (CONF-710601–, pp 31-83) REPORT ON THE CEA PROGRAM OF INVESTIGATIONS OF RADIATION-INDUCED CAVITIES IN METALS: PRESENTATION OF SOME RESULTS. Adda, Y. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Apr 1972.

From International conference on radiation-induced voids in metals; Albany, N. Y. (9 Jun 1971).

To establish the fundamental basis of void formation in irradiated metal and to correlate the damage obtained by different nature of particles, different theoretical and experimental studies were undertaken at the C.E.A. These are essentially: computer simulation of atomic displacement cascades and their thermal annealing, theoretical calculation of the nucleation and growth of voids; experimental studies of the swelling and defect supersaturation levels obtained in pure metals under neutron irradiation, and ion bombardment. An overall review of these programs is presented along with the main results. (auth)

46047 (CONF-710601–, pp 125-41) VOID FORMATION IN CLADDING AND STRUCTURAL MATERIALS IRRADIATED IN DFR. Bramman, J. I.; Bagley, K. Q.; Cawthorne, C.; Fulton, E. J. (United Kingdom Atomic Energy Authority, Dounreay (Scotland), Reactor Group). Apr 1972.

From International conference on radiation-induced voids in metals; Albany, N. Y. (9 Jun 1971).

Immersion density measurements and transmission electron microscopy studies have been carried out on specimens of four stainless steels (AISI M316 and M316L, FV548 and EN58B) and of a nickel-based precipitation-hardening alloy (Nimonic PE16), irradiated in DFR to fluences up to 8.7×10^{22} n/cm^{-2} in the temperature range 300 to 650°C. Void formation has been shown to be very sensitive to small differences in composition and pre-irradiation condition. Volume changes for a given material, condition and irradiation temperature can be adequately represented by a linear function of fluence following a threshold exposure during which no swelling of technological significance occurs. Each material studied shows a characteristic temperature dependence of swelling. (auth)

46048 (CONF-710601–, pp 156-73) FLUENCE AND TEMPERATURE DEPENDENCE OF VOID FORMATION IN HIGHLY IRRADIATED STAINLESS STEELS. Appleby, W. K.; Sandusky, D. W. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.); Wolff, U. E. (General Electric Co., Pleasanton, Calif. Vallecitos Nuclear Center). Apr 1972.

From International conference on radiation-induced voids in metals; Albany, N. Y. (9 Jun 1971).

Void formation in the 300 series austenitic stainless steels has been examined by transmission electron microscopy and the bulk swelling measured by immersion density. Specimens of Types 316 and 347 were obtained from fuel pin clads while the Type 304 was from a materials capsule. Volume increases of up to 10% were measured after fluences of up to 7.3×10^{22} n/cm^2 E > 0.1 MeV. Void size was found to increase with irradiation temperature while the void number density decreased. The upper temperature limit of void formation in Type 304 stainless steel was found to be 650 ± 15°C. At the higher fluences it was found that void nucleation had effectively ceased and that continued swelling was primarily due to void growth. Extensive intragranular precipitation in Types 316 and 347 at 525 to 550°C encouraged void nucleation. (auth)

46049 (CONF-710601–, pp 174-86) SUPPRESSION OF VOID FORMATION IN STAINLESS STEEL. Laidler, J. J. (Hanford Engineering Development Lab., Richland, Wash.). Apr 1972.

From International conference on radiation-induced voids in metals; Albany, N. Y. (9 Jun 1971).

Work is in progress at HEDL with the goal of developing a cladding material which is resistant to swelling, has good elevated-temperature mechanical properties, and meets the established criteria for LMFBR materials selection. The primary material presently under investigation is AISI Type 348 stainless steel, a niobium-stabilized austenitic alloy. By means of thermomechanical treatments, precipitation of niobium carbide can be caused to occur in association with extrinsic stacking faults. The extensive NbC precipitation which takes place not only enhances the elevated temperature tensile and creep properties of the material, but additionally provides a very high concentration of sinks and traps for point defects. The existence of a highly specific sink for vacancies appears to sufficiently alter the normal void nucleation and growth scheme that it may be possible to suppress void formation completely. Screening experiments utilizing high energy heavy ion bombardment have demonstrated the effectiveness of the microstructure of thermomechanically-treated 348 stainless steel in reduction of the tendency for swelling. Neutron-irradiated specimens have been examined recently and these results are presented. (auth)

46050 (CONF-710601–, pp 230-47) HELIUM MIGRATION IN METALS. Bauer, Walter; Wilson, W. D. (Sandia Labs., Livermore, Calif.). Apr 1972.

From International conference on radiation-induced voids in metals; Albany, N. Y. (9 Jun 1971).

Calculations and experiments on helium migration in several metals are reported. A modification of the Wedepohl method for the determination of interatomic potentials between closed-shell atoms and ions was developed and applied to helium. Both Slater and Kohn-Sham exchange approximations have been employed in the calculation of the atomic charge distributions and also in the overlap region between the atoms. Using five different potentials to describe the copper lattice, the minimum energy configuration of an interstitial He atom was determined. The (1, 0, 0) octahedral position was found to be the most stable He interstitial position, independent of the five potentials used. The activation energy for interstitial He migration was found to lie within the narrow range, .45 eV to .71 eV, and the path of migration was found to be along a ⟨110⟩ crystallographic direction. The energy required to activate a He atom from a substitutional site was found to be ~2 eV. A number of metals such as Ni, Cu, Al, Pd, and stainless steel have been implanted with 300 keV He^+ ions at 80°K. After implantation, the He outgassing was measured using isochronal and isothermal anneal schedules. Low temperature measurements were carried out in situ using a high sensitivity He mass spectrometer connected to a positive ion accelerator. At high doses (~10^{18} He atom/cm^2) significant low temperature He outgassing occurs. Most of the outgassing occurs above ~400°C as is the case at lower implantation doses. (auth)

46051 (CONF-710601–, pp 397-429) DEPENDENCE OF RADIATION EFFECTS ON THE PRIMARY RECOIL ENERGY. Robinson, Mark T. (Oak Ridge National Lab., Tenn.). Apr 1972.

From International conference on radiation-induced voids in metals; Albany, N. Y. (9 Jun 1971).

The status of the analytical theory of the displacement cascade is reviewed with emphasis on those topics of importance for neutron damage in metals. These include atomic cross sections and interatomic potentials, electronic stopping cross sections, the energy lost from displacement cascades by electron excitation, the number of defects produced in a cascade, the effects of target crystallinity, the spatial extent of cascades, and the primary recoil spectrum in neutron irradiations. (auth)

46052 (CONF-710601–, pp 430-48) VOID FORMATION IN METALS DURING ION BOMBARDMENT. Nelson, R. S.; Hudson, J. A.; Mazey, D. J.; Walters, G. P.; Williams, T. M. (Atomic Energy Research Establishment, Harwell (England)). Apr 1972.

From International conference on radiation-induced voids in metals; Albany, N. Y. (9 Jun 1971).

The fact that fast-neutron damage in metals can be qualitatively simulated by irradiation with energetic ions from particle accelerators is well known. The technique is discussed, and the conditions necessary for obtaining quantitative design data reviewed. Results are presented which point out the equivalence between the reactor and accelerator irradiations. Furthermore, a selection of results that illustrate the potential usefulness of the technique is shown. For instance, the void swelling obtained as a function of dose for nickel, 316 stainless steel, and Nimonic PE16 is compared to damage doses equivalent to well over 10^{23} neutrons/cm^2. (auth)

46053 (CONF-710601–, pp 479-98) DEUTERON-GENERATED VOID FORMATION IN AUSTENITIC STAINLESS STEELS. Armijo, J. S.; Lauritzen, T. (General Electric Co., San Jose, Calif. Breeder Reactor Dept.). Apr 1972.

From International conference on radiation-induced voids in metals; Albany, N. Y. (9 Jun 1971).

Simulation of in-reactor radiation damage in typical fast reactor core components by high-energy ion bombardment is discussed. The study was performed with several grades of austenitic stainless steel which were impregnated with helium to create an environment similar to that occurring during neutron irradiation and subsequently bombarded with deuterons. Initial experimental conditions were selected to provide a damage state comparable to that caused by a neutron fluence of 1×10^{23}. The specimens were irradiated in target assemblies instrumented to permit constant temperature monitoring and close beam focusing control. Results have revealed the existence of voids in specimens irradiated within the temperature range 400 to 665°C. The voids were observed to be predominantly polyhedral, ranging in size from 52 to 425 Å, and homogeneously distributed in any plane parallel to the bombarded surface. Void volumes as high as 6.5 percent were observed, this quantity having been measured in a region that experienced 83 displacements per atom. (auth)

46054 (CONF-710601–, pp 511-21) SWELLING AS A FUNCTION OF DISPLACEMENT DAMAGE IN PROTON-IRRADIATED 316 STAINLESS STEEL. Keefer, D. W.; Pard, A. G.; Kramer, D. (Atomics International, Canoga Park, Calif.). Apr 1972.

From International conference on radiation-induced voids in metals; Albany, N. Y. (9 Jun 1971).

Specimens of 316 stainless steel, pre-injected with about 5 appM helium, were proton irradiated at 500 and 600°C. Electron microscopy was used to determine volume swelling in specimens having undergone between 0.5 and 50 displacements per atom. Displacements were calculated from the Kinchin-Pease model with a threshold energy of 25 eV. Swelling at 500°C increased with displacement damage up to about 25% for 50 displacements per atom. No evidence of saturation of swelling with increasing damage was observed. The minimum void size increased with damage, and the void density increased with atom displacement rate. These results imply occurrence of nucleation early in the irradiation, followed by continued void growth. A specimen having undergone 100 displacements per atom at 500°C exhibited a void array which was so complex that it is doubtful that a swelling determination can be made. Ferrite, transformed from austenite during the irradiation, was observed in this specimen as small crystallites within the austenite grains. Evidence of austenite-to-ferrite transformation was obtained for specimens with about 5 or more displacements per atom. A specimen irradiated to 18 displacements per atom at 600°C exhibited frequent joining of voids to form a complex array. Preliminary examination indicates swelling at 600°C is greater than at 500°C. (auth)

46055 (CONF-710601–, pp 522-32) OBSERVATION AND THEORY OF THE VOID LATTICE IN MOLYBDENUM. Evans, J. H.; Bullough, R.; Stoneham, A. M. (Atomic Energy Research Establishment, Harwell (England)). Apr 1972.

From International conference on radiation-induced voids in metals; Albany, N. Y. (9 Jun 1971).

Experimental observations of the void lattice in molybdenum irradiated with 2 MeV N^+ ions are presented together with a theoretical explanation of its formation. Electron micrographs are presented that show the void lattice is body centered cubic and oriented precisely parallel to the underlying molybdenum atomic lattice. The theoretical explanation of this lattice is based on the conjecture that its existence must be a direct consequence of the elastic interaction between pairs of voids in the (cubic) anisotropic molybdenum. The pairwise interaction is shown to be non-central and long-ranged. This interaction has been used to show that such a stable body centered cubic void lattice can exist at a definite ratio of void lattice parameter to void radius. This result has been obtained by both explicit summation of the pairwise interaction and by a novel and exact reciprocal lattice procedure. (auth)

46056 (CONF-710601–, pp 533-49) APPLICATION OF HIGH-VOLTAGE ELECTRON MICROSCOPY TO VOID STUDIES. Buswell, J. T.; Fisher, S. B.; Harbottle, J. E.; Norris, D. I. R.; Williams, K. R. (Central Electricity Generating Board, Bristol (England), Berkeley Nuclear Labs.). Apr 1972.

From International conference on radiation-induced voids in metals; Albany, N. Y. (9 Jun 1971).

Electron irradiation with the beam of a high voltage electron microscope can produce void growth in metals, simulating the effect of high dose neutron irradiation. Thin foil specimens are employed and account must be taken of surface effects. Advantages of the technique are the high dose rate, the relative simplicity of electron irradiation and the ability to make observations continuously during irradiation. In nickel, electron irradiation produces voids only in specimens previously either implanted with gas ions or neutron irradiated. In stainless steel, voids are produced by electron irradiation alone and may be surrounded by strain fields. Direct experimental evidence is provided for dislocations acting as preferential sinks for interstitials, so promoting void growth. Comparative studies in some nickel alloys suggest that void growth depends on dislocations being free to climb and on the interstitials being free to migrate rapidly to them. For stainless steel, the effect of precipitates on void growth is discussed. In both nickel and stainless steel, voids grow at varying rates, sometimes coalescing with each other or shrinking. An analysis is given of the effects observed when neutron-irradiated nickel is thinned and subsequently electron irradiated. (auth)

46057 (CONF-710601–, pp 550-62) APPLICATION OF HIGH-VOLTAGE ELECTRON MICROSCOPY TO THE STUDY OF VOIDS AND OTHER POINT-DEFECT AGGLOMERATES. Urban, K.; Wilkens, M.; Seeger, A. (Max-Planck-Institut fuer Metallforschung, Stuttgart (West Germany)). Apr 1972.

From International conference on radiation-induced voids in metals; Albany, N. Y. (9 Jun 1971).

High-voltage electron microscopy at high temperatures provides a powerful tool for studying the nucleation and growth of defect clusters associated with void formation. This method has advantages such as very high damage rates without creation of displacement cascades, and direct observation of defect clusters and their growth. The point-defect concentrations in thin metal foils under electron irradiation were calculated. Using these calculations, it is shown how results obtained in the high-voltage electron microscope may be used to interpret effects in bulk material of technically relevant dimensions. In nickel, the formation and growth of interstitial and vacancy dislocation loops and voids during irradiation in the temperature range from 200 to about 600°C were observed. Vacancy agglomerates grew only near edge dislocations that acted as preferential sinks for interstitials. Voids were observed only in samples containing gaseous impurities. From the fact that voids occurred in samples in which the impurities were not introduced by prebombardment with high-energy gas ions it may be concluded that displacement cascades and presence of gases of extremely low solubility are not a necessary pre-requisite for void formation. (auth)

46058 (CONF-710601–, pp 563-604) VOID FORMATION IN QUENCHED OR IRRADIATED METALS. Balluffi, R. W.; Seidman, D. N. (Cornell Univ., Ithaca, N. Y. Dept. of Materials Science and Engineering). Apr 1972.

From International conference on radiation-induced voids in metals; Albany, N. Y. (9 Jun 1971).

The detailed mechanisms responsible for the formation of voids in both quenched and irradiated metals are discussed from a critical point of view. Attempts are made to correlate void formation phenomena under quenching and irradiation conditions whenever possible. Particular attention was given to the void nucleation problem and to the question of whether the nucleation is homogeneous or heterogeneous. The importance of an increased understanding of the conditions for interstitial dislocation loop nucleation in the irradiation case was emphasized. Aspects of void growth problem are considered, and the effectiveness of voids (and dislocations) as point defect sinks is discussed. A number of areas where useful experiments can be performed are pointed out. (auth)

46059 (CONF-710601–, pp 613-29) PRODUCTION OF VACANCY CONDENSATES BY LASER BOMBARDMENT. Smidt, F. A. Jr.; Metz, S. A. (Naval Research Lab., Washington, D. C.). Apr 1972.

From International conference on radiation-induced voids in metals; Albany, N. Y. (9 Jun 1971).

Bombardment of thin foils by a laser pulse of 3.5×10^{-8} sec duration and 1.5 cal/cm^2 total energy input has been found to produce high concentrations of vacancies in 99.98% pure nickel and vanadium. The vacancies condense upon annealing the foils at 0.31 T_m to form voids in nickel and faulted loops and a few isolated tetrahedra in vanadium. Although it was initially believed the vacancies formed as a result of quenching, concentrations as high as 1% or 10^2 times that expected at the melting point have been observed. The generation of vacancies by nonconservative motion of jogs does not appear feasible either because the dislocation density is too low. Interaction of shock waves generated by the laser pulse are suggested as a possible alternative explanation. The technique offers a supplementary approach to the study of vacancy condensates and the factors that affect their nucleation. (auth)

46060 (CONF-710601–, pp 672-83) EFFECT OF IRRADIATION TEMPERATURE ON SIZE OF DEFECT AGGREGATES IN COPPER. Larson, B. C.; Young, F. W. Jr. (Oak Ridge National Lab., Tenn.). Apr 1972.

From International conference on radiation-induced voids in metals; Albany, N. Y. (9 Jun 1971).

Nearly perfect copper crystals have been irradiated with 10^{18} fast neutrons per cm^2 (E > .6 MeV) at temperatures varying from 43 to 400°C, and the resulting decrease in the integrated anomalously transmitted intensities has been measured for CuK_α, MoK_α, and AgK_α x-rays. The decreases have been expressed in terms of effective absorption coefficients which are proportional to the point defect concentration and the first and second moments of the defect aggregate size distribution. These data indicate little change in the defect structure for irradiation temperatures from 43 to 200°C; however, for temperatures above 200°C the absorption coefficients rapidly increased by a factor of about 20 at 300°C, indicating a rather large increase in the sizes of the defect aggregates. This conclusion is supported by the wavelength dependence of the coefficients, line broadening of the Bragg profiles, and electron microscopy and x-ray topography. The maximum effect occurred at 300 while at 400°C (which is above the onset of stage IV annealing) there was no damage detectable for these neutron doses. Results of similar measurements made on nearly perfect aluminum crystals that had been irradiated at 43 and 127°C for doses up to 7×10^{18} n/cm^2 indicated no such effect in aluminum for these temperatures. (auth)

46061 (CONF-710601–, pp 739-56) COMPUTER SIMULATION OF ATOMIC DISPLACEMENT CASCADES IN METALS. Torrens, Ian M. (Commissariat a l'Energie Atomique, Saclay (France); Centre d'Etudes Nucleaires); Robinson, Mark T. (Oak Ridge National Lab., Tenn.). Apr 1972.

From International conference on radiation-induced voids in metals; Albany, N. Y. (9 Jun 1971).

A comprehensive computer code has been developed to simulate atomic displacement cascades in a wide variety of crystal lattices generated from primary atoms of energy up to more than 100 keV. The model includes a realistic potential for elastic atomic collisions, inelastic energy losses to electrons, and an adiabatic approximation to finite temperature effects. Results of a statistical analysis of cascades in copper and iron are presented. These include the energy variation of the total number of point defects produced, the effect of thermal vibrations on cascade development, and information on vacancy cluster distribution at the end of the cascade. Comparison is made with previous simulation results and with analytical theory. The results are used as initial data for a separate cascade thermal annealing code with the aim of obtaining information on the nucleation of voids in irradiated metals. (auth)

46062 (CONF-710601–, pp 769-97) THEORY OF VOID FORMATION AND GROWTH IN IRRADIATED MATERIALS. Bullough, R.; Perrin, R. C. (Atomic Energy Research Establishment, Harwell (England)). Apr 1972.

From International conference on radiation-induced voids in metals; Albany, N. Y. (9 Jun 1971).

A detailed theory of void formation and growth is presented and correlated to the appropriate accelerator measurements in nickel and steel. The complex dependence of the swelling phenomenon on the various physical and structural properties of the irradiated materials is discussed with particular emphasis on the various mechanisms that can prevent, slow down, or completely stop the swelling process. (auth)

46063 (CONF-710601–, pp 798-824) THEORETICAL STUDY OF THE SWELLING OF FAST-NEUTRON-IRRADIATED MATERIALS. Harkness, S. D.; Li, Che-Yu (Argonne National Lab., Ill.). Apr 1972.

From International conference on radiation-induced voids in metals; Albany, N. Y. (9 Jun 1971).

Possible mechanisms for limiting void growth under fast neutron irradiation are analyzed. It is found that the void volume at which saturation should occur is dependent on the void number density. Higher void number densities lead to lower void volumes at saturation. The importance of knowing the generation rate of Frenkel pairs that can participate in diffusional processes rather than the total number of displaced atoms is discussed. It is stressed that this could be especially important in translating results gained by proton bombardment. The relationship between the development of voids under heavy ion and under neutron bombardment is considered using a theoretically based computer model. In this model void nucleation is taken as the sum of a homogeneous nucleation rate and a heterogeneous term. The homogeneous nucleation rate is taken as that recently derived by Russell and by Katz and Wiedersich. The heterogeneous nucleation rate is an empirically fitted term based on the form expected from nucleation by helium. It is found that homogeneous nucleation can adequately explain the results from heavy ion bombardments where the target was not previously injected with helium. Homogeneous nucleation in EBR-II irradiations is only found to be important for short exposures ($nvt < 10^{22}$ n/cm^2) at irradiation temperatures below 400°C. (auth)

46064 (CONF-710601–, pp 825-40) NUCLEATION OF VOIDS IN MATERIALS DURING HIGH-ENERGY IRRADIATION. Katz, Joseph L. (Clarkson Coll. of Tech., Potsdam, N. Y. Dept. of Chemical Engineering); Wiedersich, Hartmut (North American Rockwell Corp., Thousand Oaks, Calif. Science Center). Apr 1972.

From International conference on radiation-induced voids in metals; Albany, N. Y. (9 Jun 1971).

High energy radiation simultaneously produces vacancies and interstitials in crystalline materials. The nucleation of defect precipitates under this circumstance is fundamentally different from the usual nucleation problem because of the competing effects of interstitials and vacancies on the size distribution of precipitate embryos. The rate of homogeneous nucleation of voids in such a material, in which interstitials as well as vacancies are supersaturated, is derived. It is shown that from thermodynamics only n°(x), the distribution of void sizes when the interstitials are in equilibrium with the vacancies can be obtained. The constrained equilibrium distribution of voids n(x) when the interstitials are also supersaturated is determined by the kinetics of incorporation of vacancies and interstitials into the embryos. Explicit expressions are given for n(x) in terms of kinetic parameters in n°(x). The rate of nucleation is then derived from n(x) along lines similar to classical nucleation theory. It is found that the supersaturation of defects which occur during irradiation in a high flux of energetic neutrons or ions is sufficient for readily observable nucleation rates of voids at intermediate temperatures but insufficient at high temperatures. (auth)

46065 (CONF-710601–, pp 841-52) EFFECT OF STRESS ON RADIATION-INDUCED VOID GROWTH. Garner, F. A.; Wolfer, W. G.; Biancheria, A.; Boltax, A. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). Apr 1972.

From International conference on radiation-induced voids in metals; Albany, N. Y. (9 Jun 1971).

The influence of applied stress on the radiation-induced density changes observed in fast reactor structural materials is currently under study. Candidate mechanisms being investigated as potential contributors to density changes include the growth of grain boundary cavities or helium bubbles under tension; the volume change associated with the hydrostatic component of irradiation creep; and the growth of voids under conditions of externally applied stress. Emphasis is placed on the last mechanism. The changes in point defect currents that arise in the vicinity of voids in a stressed matrix is also investigated. (auth)

46066 (COO–3431-1) STUDY OF RADIATION INDUCED DEFECTS IN METALS. Final Report, January 15, 1966–January 14, 1972. Townsend, John R. (Pittsburgh Univ., Pa. Dept. of Physics). 5 Jun 1972. Contract AT(11-1)-3431. 6p. Dep. NTIS.

The topics discussed fall under three major categories: (1) effects of low temperature proton irradiation on the Young's modulus and internal friction of copper and tungsten, (2) computer simulation of point lattice defects and the resulting changes in the elastic bulk modulus, and (3) piezo-resistance in metals arising from stress-induced ordering of point defects. (auth)

46067 (HEDL-TME–71-126) RECOVERY AND RECRYSTALLIZATION OF PROTOTYPIC FTR FUEL CLADDING: 20 PERCENT CW 316 STAINLESS STEEL TUBING (RM-11). Paxton, M. M.; Holmes, J. J. (Hanford Engineering Development Lab., Richland, Wash.). Sep 1971. Contract AT(45-1)-2170. 25p. Dep. NTIS.

Design, performance and safety analyses of FTR core components are presently based on conservative property estimates because knowledge concerning the thermal stability of cold-work in Type 316 stainless steel is meager. Information concerning the retention of cold-work properties in 316 SS after exposure to the FTR core environment is presented. It appears that at all operating temperatures below 1200°F, use of a factor representing 75% of the tensile strength of 20% CW 316 SS as a design assumption is warranted. (auth)

46068 (ORNL-TM–3733) POSTIRRADIATION MECHANICAL PROPERTIES OF TYPES 304 AND 304 + 0.15 PERCENT Ti STAINLESS STEEL. Bloom, E. E.; Stiegler, J. O. (Oak Ridge National Lab., Tenn.). Jul 1972. Contract W-7405-eng-26. 30p. Dep. NTIS.

The tensile and creep-rupture properties of Types 304 and 304 + 0.15% Ti stainless steels have been determined after irradiation at temperatures in the range 400 to 820°C to maximum neutron fluences of 3.5×10^{22} neutrons/cm^2 (>0.1 MeV). Changes in mechanical properties were related to the microscopic observations of irradiation-produced defects. When irradiated in the annealed condition in the neighborhood of 450°C, Type 304 stainless steel exhibited an increased yield stress, reduced strain hardening coefficient, and reduced uniform and total elongation. The increased yield stress could be correlated with the strengthening expected from irradiation-produced voids and dislocations. With increasing irradiation temperature the concentration of these defects decreased and thus the magnitude of the yield stress increase became less. At 500 to about 600°C irradiation and test temperature a pronounced reduction in creep-rupture ductility was observed. Fractures were intergranular. It is suggested that in this temperature range the void-dislocation structure together with the transmutation-produced helium were responsible for the intergranular fractures and low ductilities. At higher temperatures no void-dislocation structures were formed. For these conditions the ductilities were higher than in the 500 to 600°C range but still significantly below the unirradiated value. Variation in alloy composition and preirradiation microstructure had a strong influence on the postirradiation properties. Type 304 + 0.15% Ti stainless steel exhibited significantly higher tensile and creep-rupture ductilities than the standard alloy when irradiated and tested above 450°C. The strength properties of specimens irradiated in the 10% cold-worked condition were similar to those of material irradiated in the annealed condition, but the total elongation and reduction in area were slightly lower. (auth)

46069 (UJV–2795-M) ROLE OF STATISTICAL FLUCTUATIONS IN TEXTURE DURING THE RADIATION GROWTH IN URANIUM. Novak, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). 1972. 11p. (In Czech). Dep. NTIS (U. S. Sales Only).

The effects of statistical fluctuations of the preferred orientation of uranium grains on the fuel element distortion under irradiation were examined. It has been supposed for simplicity that uranium grains grow under irradiation in direction b and contract isotropically in perpendicular directions. The model yielded a value of mean square of the angle between directions of the axis of the distorted cylindrical specimen determined at both basal planes of the cylinder as a function of the radiation growth of individual grains, of the grain size, and of geometry of the cylindrical specimen. Numerical values obtained using the model were in accordance with the result of an irradiation experiment. (auth)

46070 (UJV–2798-M) DEFORMATION OF FUEL ELEMENT RODS DURING IRRADIATION. Novak, J.; Pelcik, E. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). 1972. 25p. (In Czech). Dep. NTIS (U. S. Sales Only).

Temperature and stress dependence of the axial deformation rate of the metallic uranium cylindrical fuel elements during irradiation in a gas loop of the reactor VVRS has been studied. The temperature of uranium was below 350°C. The results showed an influence of the can on fuel element deformation. (auth)

46071 IRRADIATION EFFECTS ON STRUCTURAL MATERIALS. I. RADIATION HARDENING. Bement, A. L. Jr. (Massachusetts Inst. of Tech., Cambridge). Rev. Roum. Phys.; 17: No. 3, 361-80(1972).

A fundamental discussion on neutron radiation hardening is given under the following topics: dispersed barrier hardening, temperature dependence, impurity effects, strain hardenability, and grain size effects. (66 references) (P.C.H.)

46072 CORRELATION OF IRRADIATION DATA USING ACTIVATION FLUENCES AND IRRADIATION TEMPERATURE. Lynch, John H. (Lewis Research Center, Sandusky, Ohio). Nucl. Technol.; 15: No. 3, 411-21(Sep 1972).

A new method of correlating radiation damage data is tested using data taken from the open literature. This method, the activation fluence method, was found to be as accurate as other contemporary models with which it was compared. The new method also has several advantages over the other methods. The method employs a new entity, the activation fluence (time integrated specific activation rate), as the independent variables in a regression model. Temperature at which the irradiation takes place is also a variable. Although the method was treated for a specific type of damage (change in nilductility transition temperature for A302-B steel) it has no inherent restrictions and is limited only by the imagination of the user. (auth)

46073 ROOM TEMPERATURE INTERNAL FRICTION OF NEUTRON-IRRADIATED ALUMINUM. Bose, S. K.; Mishra, R.; Bhattacharya, D. L. (Banaras Hindu Univ., India). Indian J. Pure Appl. Phys.; 10: No. 1, 21-2(Jan 1972).

It has been observed that at low frequencies (~1 Hz) the amplitude-independent room temperature internal friction (Δ_i) of a neutron-irradiated aluminium wire specimen has always a value higher than that of an annealed specimen. It is possible to explain the observed effect in terms of an increase in the mean distance (L_c) between two pinning points on dislocation lines. The breakaway stress value of an irradiated and annealed specimen has also been explained in terms of a slightly modified Granato-Luecke theory. (auth)

46074 RANGES OF FISSION FRAGMENTS IN URANIUM–ALUMINUM ALLOYS AND URANIUM OXIDES. Saeki, Masakatsu; Ishimori, Tomitaro (Japan Atomic Energy Research Inst., Ibaraki). Nippon Genshiryoku Gakkaishi; 14: No. 6, 278-82(Jun 1972). (In Japanese).

The mean ranges of 6 fission fragments (^{91}Y, ^{95}Zr, ^{99}Mo, ^{132}Te, ^{140}Ba and ^{141}Ce) have been determined in U–Al alloys (4.66, 16.20, 20.15 wt% U), UO_2, and U_3O_8 by radiochemical measurement. The results obtained are tabulated. (auth)

46075 CHANGE IN LINEAR DIMENSIONS OF METALS UNDER THE INFLUENCE OF γ RADIATION. Gurevich, M. E.; Shalaev, A. M. (Inst. of Metal Physics, Kiev). Metallofizika; No. 36, 113-15(1971). (In Russian).

The change in length, $\Delta l/l$ of samples of Al, Ni, Cu, and Mo, which had been irradiated with 10^9 R of ^{60}Co gamma radiation, was experimentally measured during subsequent isochronous annealing. Dimensional change was associated with the annealing of point defects, which had been produced by γ irradiation. (tr-auth)

46076 FORMATION OF DEFECTS IN A CRYSTALLINE LATTICE DURING IRRADIATION OF METALS AND ALLOYS (A REVIEW). Shalaev, A. M. (Inst. of Metal Physics, Kiev). Metallofizika; No. 34, 5-20(1971). (In Russian).

A literature survey was made of theoretical and experimental work conducted on radiation defects in metals and alloys. Primary and secondary effects are differentiated. The displacement of atoms by neutrons, gamma radiation such as that from ^{60}Co, and electrons is considered. (52 references). (K.S.W.)

Other Materials

Refer also to abstracts: 45338, 45944, 46013, and 47225.

46077 (GULF-GA-A-12035) IRRADIATION-INDUCED DIMENSIONAL CHANGE IN HTGR CONTROL MATERIALS. Stansfield, O. M. (Gulf General Atomic Co., San Diego, Calif.). 28 Apr 1972. Contract AT(04-3)-167. 27p. (CONF-720420-8). Dep. NTIS.

From Conference on reactor materials performance; Richland, WA. (24 Apr 1972).

Boronated graphites containing 22 to 43 wt % boron as B_4C and representing current warm-pressing or extrusion technology were irradiated at 650 ± 100°C to fast neutron fluences up to 7×10^{21} n/cm^2 (E > 0.18 MeV). The irradiation caused an increase in thermal expansivity, a decrease in thermal conductivity, and an anisotropic dimensional change related to the preferred orientation of the graphite crystallites in the graphite matrix. Although irradiation-induced B_4C swelling has been reported, the dimensional change in boronated graphite is not significantly influenced by that effect. Dimensional change in boronated graphite is controlled by the fast neutron and ^{10}B fission damage irradiation properties of the graphite-binder matrix. At a constant ^{10}B-isotope concentration, the irradiation-induced dimensional change of the boronated graphite increases with increasing ^{10}B-isotope enrichment of the boron in the B_4C addition. This effect, which may result from more severe ^{10}B fission fragment damage in the matrix surrounding ^{10}B-enriched B_4C, leads to distortion directly related to the ^{10}B burnup gradient. The use of natural boron in the fabrication of boronated graphite results in dimensional changes independent of the ^{10}B burnup gradient and correlated with fast neutron fluence under HTGR service conditions. (auth)

46078 (NYO–1710-106) RESEARCH ON GRAPHITE. Final Report for Work Completed During the Period 1954 to 1972. Walker, P. L. Jr.; Kline, D. E.; Thrower, P. A. (Pennsylvania State Univ., University Park. Dept. of Materials Science). 30 Jun 1972. Contract AT(30-1)-1710. 28p. Dep. NTIS.

Major areas of research on carbons and graphite under the contract include carbon formation and graphitization (1954 to 1972), gas-graphite interaction and solid state studies (1954 to 1972), dynamic mechanical properties of graphites and carbons (1966 to 1972), and radiation damage to graphite (1968 to 1972). Based on research results, over 100 technical publications were written. A complete list of these publications is given along with a list of papers submitted for publication. In this way the extent of text material has been kept to a minimum, with only what are considered the major accomplishments being emphasized. (J.R.D.)

46079 (UCRL-Trans-10622) EQUATION OF STATE FOR LIQUID AMMONIA. Planck, R. Translated for Univ. of California Lawrence Livermore Lab., Livermore, from Kaeltetechnik; 12: No. 10, 282-3(1960). 4p. Dep. NTIS.

The specific volume of liquid ammonia as a function of pressure and temperature may be calculated very accurately by means of an equation given by Eucken. The numerical constants of this equation are presented. The numerical evaluation is relatively easy. (auth)

46080 USE OF REINFORCED PLASTIC IN A URANIUM PRODUCTION FACTORY. Walz, Albert. Corros.-Trait., Prot., Finition; 20: No. 2, 155-8(Mar 1972). (In French).

Various equipment of uranium production factory was exposed to severe corrosion conditions: installations for obtaining uranium oxide from ore by solvent extraction methods; installations for the processing of uranium oxide. The Cother corporation factory of Canon City extensively utilizes SVR reinforced plastics in their chemical plants for corrosion protection. The manufacture of SVR ATLAC 382 and its application to the development of solvent extraction tanks is described. (France)

46081 COMPARATIVE EFFECTS OF ION BOMBARDMENT AND PARTIAL PRESSURES ON SHEET POLYETHYLENE. Antoniou, Antoine; Bui Ai; Lacoste, Robert; Mayoux, Christian (Ecole Nationale Superieure d'Electrotechnique d'Informatique, et d'Hydraulique, Toulouse). Compt. Rend., Ser. B; 274: No. 16, 955-8(17 Apr 1972). (In French).

The damage caused on polyethylene by ion beams (200 to 2000 eV) was studied and compared to that induced by partial discharges. Observations by multiple and specular reflexions in infrared spectroscopy revealed structural changes. The existence of a proportional law between the particle mass and the damage rate being established, two hypotheses to explain the material erosion by the discharges are proposed. (France)

46082 AEROSOLS PRODUCED BY X-RAYS. Keng, Edward Y. H.; Chu, Richard R. C.; Knight, James A. Jr.; Orr, Clyde Jr. (Georgia Inst. of Tech., Atlanta). J. Colloid Interface Sci.; 39: No. 1, 94-102(Apr 1972).

Small proportions of organic vapors in air produce aerosols under the influence of x-rays. The particulates are generally spherical in shape and less than a micron in diameter. Those formed from acetylene and benzene vapor appear yellow and brown, respectively. They are essentially nonvolatile at room temperature and are very stable even when exposed to the high vacuum of an electron microscope. However, a substantial size reduction was attained by several hours of heating at 250°C under atmospheric pressure. The size and quantity of the particulates formed under x-irradiation depend on the organic vapor, its concentration, the humidity of the air, the intensity of the x-rays, irradiation time, and aging time after exposure. The growth and formation of particulates do not stop immediately after exposure ceases. Infrared spectrum analysis provides information on the chemical structure of the particulates. (auth)

46083 METHOD AND APPARATUS FOR COUNTING RADIATION DAMAGE TRACKS IN SHEET MATERIAL USING A CAPACITIVE DISCHARGE DEVICE. Cross, William Gunn; Tommasino, Luigi (to Atomic Energy of Canada Ltd.). U. S. Patent 3,663,815. 16 May 1972. Priority date 18 Feb 1969, Canada.

Fission fragment tracks produced in sheet mica and other electrical insulating materials of radiation dosimeters are counted by leaching the tracks so that they provide electrical discharge paths through the sheet, placing an aluminum foil on top of the sheet, applying a voltage between an electrode covering the underside of the sheet and the foil to sequentially puncture the foil by electrical discharges through the tracks and counting the discharges. (Official Gazette)

46084 MORPHOLOGY AND MECHANICAL PROPERTIES OF CELLULOSE ACETATE GRAFTED WITH POLYACRYLONITRILE. Siahkolah, Mohammed Ali. Raleigh, N. C.; North Carolina State Univ. (1972). 201p. University Microfilms Order No. 72-17,740.

Thesis.

Stretched and normal (unstretched) cellulose acetate yarns were grafted with acrylonitrile monomer from the vapor-phase using γ irradiation as the graft initiator. The grafted samples, in general, were characterized by measuring and studying their tenacity, orientation, amount of the actual graft and the parent homopolymers, moisture regains before and after saponification, homogeneity, compatibility, graphitizability, and finally their electron micrographs. The dynamic mechanical properties of the grafted samples were measured by Vibron and were thoroughly studied. Attempts were made to correlate the experimental results to those calculated based on certain mechanical models. Finally, the molecular relaxation time, τ, a characteristic of the system, was found by subjecting the grafted and ungrafted samples to successive interval sorption tests with acetone. A new method was found to calculate the relaxation times throughout the whole course of the experiment, with a more accurate value. These and other experimental methods showed that the cellulose acetate grafted with polyacrylonitrile is a rather homogeneous system. These two polymers construct the grafted system such that it may be considered to be in the form of two continuous interpenetrating matrices. These matrices not only share the external load based on their relative compositions, but due to the presence of a special kind of crosslinking the modulus tends to be higher than the calculated value. The segmental environments of the grafted samples are believed to be relatively heterogeneous. However, evidence for the existence of any aggregates of like-molecules to an appreciable size that could scatter the light and lead to an opaque film was lacking. (Diss. Abstr. Int., B)

46085 SYNTHESIS AND STUDY OF LANTHANIDE PEROXIDES. Bogdanov, G. A.; Selivanova, M. N.; Garkushenko, T. L. (Moscow Technical Inst.). Zh. Neorg. Khim.; 17: No. 3, 616-20(Mar 1972). (In Russian).

New peroxides of La, Sm, Er, and Lu were synthesized, and it was noted that the ability to form peroxide compounds increased from La to Lu. The stability of a given lanthanide was inversely proportional to the quantity of peroxide groups attached to it. Differential heating curves suggest a complex character; the peroxides decompose gradually, releasing oxygen and water and causing some exo- and endo-effects. (tr-auth)

46086 RESEARCH AND DEVELOPMENT ON GRAPHITE IN THE FEDERAL REPUBLIC OF GERMANY. Fitzer, E. (Univ., Karlsruhe, Ger.). Ber. Deut. Keram. Ges.; 49: No. 5, 141-9 (May 1972). (In German).

Research institutions as well as the most important research and development results with respect to artificial carbon products are surveyed. The trend for future application of artificial carbon products is outlined. In addition to the broad application in filaments, felts, and fibers for reinforcement of netted or thermoplastic polymers, special application of carbon fiber reinforcement of compound materials is discussed with respect to ultracentrifuges and rotor blades of helicopters. Of great interest is the construction of a carbon fiber-reinforced glider with wings of 30 m span. Such wingspans were not considered before. (H.B.G.)

46087 EFFECT OF NUCLEAR RADIATIONS ON RUBBER JOINTS. Monnier, Bernard; Van de Voorde, Marcel (CERN, Geneva). Ind. At. Spatiales; 26: No. 1, 39-50(Jan 1972). (In French).

The CERN undertook studies for the determination of the most suitable rubber for vacuum techniques in a radioactive environment. The changes in the various mechanical characteristics with the different absorbed doses were used to determine the limits of each type of rubber. (France)

46088 PULSED METHOD FOR IMPREGNATION OF GRAPHITE. Beatty, Ronald L.; Kiplinger, Dale V. (to United States Atomic Energy Commission). U. S. Patent 3,664,859. 23 May 1972. Filed 4 Mar 1969.

An improved method for preparing carbon-impregnated graphite bodies is provided comprising pulsing the graphite bodies between a vacuum atmosphere and a pressurized hydrocarbon atmosphere at elevated temperatures. The resulting graphite bodies, which are impregnated with pyrolytic carbon deposits, have helium permeabilities of less than 1×10^{-11} cm^2/sec. (AEC)

46089 ADHERING RESINS TO SUBSTRATES, ESPECIALLY METAL, BY RADIATION. Hall, Roger P.; Pratt, Ivor; Young, Richard A. (to SCM Corp.). U. S. Patent 3,669,796. 13 Jun 1972. Filed 3 Oct 1968.

A process for radioinduced coating of a substrate, and especially one having a metallic surface, with a substantially catalyst-free system containing a polymerizable organic unsaturated resin susceptible to free-radical catalysis; and the resulting product are described. In one form, a film of the resin is superimposed on the substrate while a facing side of either the resinous film or substrate is contacted at any time prior to such radiation with an organic substituted, radiation-responsive silane, or derivative thereof such as a siloxane or polysiloxane of the silane. Thereafter, the film and substrate are subjected to high-energy radiation to induce adherence of one to the other. The process is also adapted for coating articles with normally air-inhibited, thermosetting resins by a two-step process, wherein the resin film is first passed through one treating zone effective to impart mass integrity and thereby define a sheet, and the sheet together with the silane and the substrate is then passed through another treating zone effective substantially to complete the cure of the resin and simultaneously adhere the sheet to the substrate, at least one of the treating zones comprising exposure to high energy radiation. (Official Gazette)

46090 USE OF IRRADIATION IN PLASTIC WASTES DISPOSAL. Tanaka, Masaru; Mifune, Tsuyoshi (Wayne State Univ., Detroit). J. Sanit. Eng. Div., Amer. Soc. Civil Eng.; 98: SA-3, 561-7(Jun 1972).

Radioinduced embrittlement of plastics for promotion of waste disposal by consolidation was investigated. Results of embrittlement reactions caused by fast electrons are reported for widely used plastic materials such as polyvinyl chloride and polyethylene. It was found that extended irradiation is required to render these plastics brittle enough for mechanical consolidation. The method cannot be recommended for commercial use. (J.R.D.)

46091 SURFACE TENSION OF STRESS-ANNEALED PYROLYTIC GRAPHITE. Morcos, Ikram (Hydro-Quebec Inst. of Research, Varennes, Quebec). J. Chem. Phys.; 57: No. 4, 1801-2(15 Aug 1972).

Previous measurements and some of the assumptions made in calculating γ_s for cleavage graphite are discussed. Neumann's derivation of Good's equation is given: $\cos\theta = [(0.015\,\gamma_s - 2)(\gamma_s\gamma_L)^{1/2} + \gamma_L]/\gamma_L\,[0.015(\gamma_s\gamma_L)^{1/2} - 1]$. Advancing and receding meniscus measurements were made with five liquids on stress-annealed highly oriented type Z Y H graphite at 25°C. The results indicate that γ_s is probably ~34.6 dyn/cm. The lower γ_s values (26.5 and 28.75 dyn/cm) obtained with CCl_4 and acetonitrile are due to the γ_L being lower than γ_s and the consequent adsorption of vapors on the graphite surface. (D.L.C.)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

Refer also to abstracts: 45183–45186, 45190, 45191, 45587, and 46148.

46092 (BNL–16930) CONTINUOUS SAMPLING PLAN FOR THE TAKING OF PHYSICAL INVENTORIES. Epel, L. G.; Marcuse, W.; Zucker, M. S. (Brookhaven National Lab., Upton, N. Y.). Jun 1972. 13p. (CONF-720529–3). Dep. NTIS.

From thirteenth annual meeting of the Institute of Nuclear Materials Management; Boston, MA. (31 May 1972).

One method of performing a periodic physical inventory involves the stopping of flows into and out of the material balance area being inventoried, determining that all items appearing in the records are actually in inventory, and weighing and sampling a subset of these items on a random basis for chemical and/or isotopic analyses. This procedure may interfere with production, will intermittently load the analytical laboratories, and results in delays in establishing the amount of special nuclear material that is in inventory. These undesirable effects become more onerous as the period between physical inventories is shortened. A continuous sampling plan is described that eliminates these effects and in addition makes possible a more continual knowledge of the inventory. Further, with this plan and under proper conditions of flow and inventory size, a potential for reducing the total number of samples required to achieve equivalence with the usual method of establishing an inventory exists. The continuous sampling plan is based on a stochastic process of shipping and sampling items that yields a probabilistic model for the number of items in inventory that have been sampled at any time. The expected value of the number of sampled items can be made equal to the number of sampled items in the usual inventory method by a suitable choice of parameters. Further, any function that depends on the number of sampled items in inventory also becomes a random variable and can be made to have the same expected value as it has in the periodic physical inventory method. (auth)

46093 (ICP–1014) EVALUATION OF INSTRUMENTATION FOR NUCLEAR FUELS REPROCESSING PLANT INPUT WEIGHT MEASUREMENTS. Groth, F. M.; Cartan, F. O. (Allied Chemical Corp., Idaho Falls, Idaho. Idaho Chemical Programs Operations Office). Jul 1972. Contract AT(10-1)-1375. 33p. Dep. NTIS.

Results of a study at the Idaho Chemical Processing Plant were used to evaluate instrumentation for measurement of plant input solution weight. A system to directly weigh up to five tons of radioactive solution in an input accountability tank was installed and calibrated but found to be unsatisfactory in this installation. Two methods to determine liquid weight using its pressure in a tank were also investigated, including complete error analyses. A precision pressure transducer measurement of solution weight gave a 0.10% standard deviation—the best among those instruments evaluated. Recommendations for improving input weight measurements are given. (auth)

46094 (WASH–1210) ATTRIBUTE SAMPLING INSPECTION PROCEDURE BASED ON THE HYPERGEOMETRIC DISTRIBUTION. Sherr, Theodore S. (Division of Nuclear Materials Security (AEC), Washington, D. C.). May 1972. 215p. Dep. GPO $1.75.

A procedure for attribute sampling inspection is described. Tables are presented which indicate the minimum sample size and associated acceptance number for lot sizes from 1 to 5600 which satisfy specified combinations of risks. Tables are included for sixteen choices of risk combinations. Also presented are computer programs which, first, enable generation of tables for combinations of risks not included and second, provide a basis for investigating implications of varying sample sizes and acceptance numbers. (auth)

46095 URANIUM AND THE BALANCE OF POWER. World Miner. Metals; No. 7, 15–21(1972).

Power policy rather than politics may prove to be the biggest problem facing governments throughout the world as the 20th century reaches its closing years. This article examines the special case of uranium, at present the "Cinderella" of the energy industry, which seems destined very soon to meet its political and financial "Prince Charming." Among matters discussed are: availability of uranium ore and uranium enrichment progress. (auth)

46096 ATOMIC SAFEGUARDS: A STUDY IN INTERNATIONAL VERIFICATION. McKnight, Allan. UNITAR Series No. 5. New York; United Nations Institute for Training and Research (1971). 323p. $6.50.

The safeguards system of the IAEA is examined in detail. Information is presented on the political development of the IAEA safeguards from 1946 to 1970 and the executive administration of the IAEA safeguards. A 42-item bibliography and a 9-item supplement containing: notes on international laws relevant to IAEA safeguards, on treaties and their verification, and on nuclear industry and commerce; statute of the IAEA; IAEA document INFCIRC/66/Rev. 2 on IAEA safeguards system; Treaty on the Non-Proliferation of Nuclear Weapons; Treaty for the Prohibition of Nuclear Weapons in Latin America; and the agreement between the IAEA and Mexico are included. (L.C.L.)

46097 FUEL ASSEMBLY IDENTIFICATION. ANSI N18.3-1972. Hinsdale, Ill.; American Nuclear Society (1972). 2p.

A standard prescribing requirements for fuel assembly identification (ANSI N 18.3-1972) for nuclear and associated applications is presented. (J.R.D.)

Disposal and Storage

Refer also to abstracts: 45565, 46090, and 46238.

46098 (AAEC/TM–628) MANAGEMENT OF WASTES FROM IRRADIATED NUCLEAR FUELS. Hespe, E. D.; Hardy, C. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). 1972. 19p. (CONF-720627–1). Dep. NTIS (U. S. Sales Only).

From Symposium on the role of nuclear energy in Australia's development; Canberra, Australia (1 Jun 1972).

The fuel of present and future proposed power reactors has to be withdrawn from the reactor before all the fissile material is used, and it is economically desirable to recover this material. About 99.9% of the fission products present in the irradiated fuel is usually isolated in an aqueous nitrate solution in the reprocessing plant which recovers the unused uranium and the newly-created plutonium. It is this waste which, without proper management, could present a significant radiological hazard to this and future generations. Because of their abundance and relatively long half-lives, the fission product isotopes of most concern are cesium-137 and strontium-90. Small amounts of transuranic elements are also of concern because they have very long half-lives and high radiotoxicity. The amount of waste produced is proportional to the total nuclear power production and it will require surveillance for thousands of years. The wastes release up to 20 kilowatts of energy per ton of fuel reprocessed and hence may require cooling in the early years of storage. The main concern in waste management is the possibility that the wastes may become dispersed in the environment, be ingested by man, and thus expose him to internal radiation injury. All the major producers of these wastes use some form of storage in tanks as an interim measure. All have worked, or are working, on the development of processes to convert the wastes to insoluble high melting-point solids for final storage. The methods of ultimate disposal of the solids that have been developed so far, or have been proposed, are reviewed. Significant amounts of irradiated fuel are unlikely to arise from an Australian nuclear power program before the 1980s and the various factors which will have to be considered before a decision is taken to build a reprocessing plant are listed. An important question is where the long-term responsibility for waste management should lie, and this is discussed briefly. Responsible people in Western Europe have recently expressed confidence that the use of nuclear power need not be limited by waste management problems. Australia is fortunate in being able to observe and profit from the experiences of other countries, and it is concluded that the role of nuclear energy in Australia's development will not be limited by these problems. (auth)

46099 (ARH-SA–117) REMOTE WELDING PROGRAM FOR ATLANTIC RICHFIELD HANFORD COMPANY'S WASTE ENCAPSULATION AND STORAGE FACILITY. Wormell, John C. (Atlantic Richfield Hanford Co., Richland, Wash.). 4 May 1972. 22p. (CONF-720903–11). Dep. NTIS.

From twentieth remote systems technology conference; Idaho Falls, ID. (17 Sep 1972).

Features of nondestructive testing capabilities incorporated into welding equipment for remote operations are described. Descriptions are included of the waste encapsulation and storage

facility, capsule materials, capsule fabrication for storage of ^{137}Cs and ^{90}Sr, and in-cell welding equipment and operation. (J.R.D.)

46100 (CONF-720903-4) BURIAL OF RADIOACTIVE WASTE IN SALT. Frederick, E. J. (Oak Ridge National Lab., Tenn.). 1972. 15p. Dep. NTIS.

From twentieth remote systems technology conference; Idaho Falls, ID. (17 Sep 1972).

The use of natural salt formations for the long-term storage of radioactive waste has been actively studied at ORNL since 1957. Results of these studies, which included Project Salt Vault, a field-scale experiment, confirmed the feasibility of this concept and provided data for the design of an actual waste repository. A conceptual design of a repository for demonstrating storage of both solidified high-level fuel reprocessing wastes and alpha-contaminated solid wastes was completed in April 1971. The rationale of using salt deposits for storage of radioactive waste, siting considerations in locating a repository, the operating concepts developed during the conceptual design for the handling and burial of the solidified high-level wastes, and the long-term geological effects on the area surrounding a repository are discussed. (auth)

46101 (IAEA-136, pp 10-17) TECHNICAL STUDIES CONNECTED WITH THE RELEASE OF RADIOACTIVE WASTES INTO THE SEA. (International Atomic Energy Agency, Vienna (Austria)). 1971. INIS.

The Laboratory convened a Panel on Procedures for Establishing Limits for Radionuclides in the sea at which 15 papers were presented. A review of subjects related to marine radioactivity is under preparation. Investigations are under way on studies of non-radioactive pollutants by methods used in marine radioactivity studies, particularly in connection with mercury pollution; the horizontal diffusion of pollutants on the sea surface is being investigated in collaboration with the German Hydrographic Institute in Hamburg and the possible role of euphausiids in the biological transport of radionuclides is being investigated by the Laboratory. (auth)

46102 (ORNL-tr-2369) SOME PROBLEMS OF THE DISCHARGE OF RADIOACTIVE GASES AND AEROSOLS FROM NUCLEAR FACILITIES INTO THE ATMOSPHERE. Zindler, H. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Translated for Oak Ridge National Lab., Tenn., from report SZS-17/69. 12p. Dep. NTIS.

An abstract of this paper, prepared from the original language, appeared as NSA 24: 25252.

46103 RADIOACTIVE WASTE STORAGE SYSTEM AND METHOD. Sayers, Robert P. (to FMC Corp.). U. S. Patent 3,663,817. 16 May 1972. Filed 28 Jul 1969.

A system and method for storing radioactive waste are described, wherein the waste is placed in receptacles and the receptacles are moved selectively along a plurality of storage paths. The receptacles are retained selectively on the paths for periods of time dependent upon the periods required for the radioactivity of the contained waste to decay to predetermined levels. (Official Gazette)

Handling Equipment and Procedures

Refer also to abstract: 47011.

46104 (LA-DC-72-556) CELLS FOR NONDESTRUCTIVE EXAMINATIONS OF IRRADIATED FUEL PINS. Fitzgibbon, F. J.; Montgomery, C. D.; Trujillo, J. R. (Los Alamos Scientific Lab., N. Mex.). 1972. 7p. (CONF-720903-3). Dep. NTIS.

From twentieth remote systems technology conference; Idaho Falls, ID. (17 Sep 1972).

In October 1970 a decision was made to reactivate four LASL plutonium hot cells to conduct nondestructive postirradiation examination (PIE) of irradiated fuels sent to LASL at the request of the USAEC. These cells had been designed for research and development work on reprocessing irradiated plutonium reactor fuel and had been operational for a number of years. To make the cells suitable and efficient for the PIE of irradiated fuels, a number of modifications had to be considered and implemented to satisfy the planned examinations. The changes and additions made to the existing building are described; operational procedures are not discussed. (auth)

46105 (ORNL-tr-2371) WAK: SPECIFICATIONS AND FINISHING CONTROL FOR EQUIPMENT. Clauss, W.; Issel, W.; Warchold, L.; Meininghaus, H. Translated for Oak Ridge National Lab., Tenn., from Atomwirt., Atomtech., 15: 84-9 (1970). 15p. Dep. NTIS.

All supplies were individually ordered by following the principle of "safety before economy." The suppliers were responsible for observing the specifications which were set in about 100 technical delivery and acceptance conditions (TDA). The documents submitted for examination were inspected primarily by Institute of Reactor Safety (IRS) and Technical Control Association (TUV) (Baden), while quality control was the responsibility of TUV of Baden and the local TUV. The limitation in the number of TDA's also leads to the highest quality conditions for less highly stressed components. (auth)

46106 (ORNL-tr-2372) SPECIAL MACHINES AND EQUIPMENT OF WAK. Geier, H.; Hoffmann, W.; Huppert, K. L.; Zimmermann, G.; Roth, B. F. Translated for Oak Ridge National Lab., Tenn., from Atomwirt., Atomtech.; 15: No. 2, 89-94(1970). 15p. Dep. NTIS.

The experimental nature of WAK justifies the remaining necessary development and testing of special equipment. Equipment which is specific for a process and which differs from conventional chemical engineering equipment is described. For the head-end process, this involves the disassembly machine on which the irradiated fuel assemblies are disassembled by sawing and grinding into the individual pins. Other paragraphs deal with the various extractors utilized as well as with a newly developed system for remote sampling from radioactive process solutions. (auth)

46107 (UCRL-73756) SHIELDED CAVES FOR DUAL-MODE OPERATION. Hanson, C. L.; Coops, M. S. (California Univ., Livermore. Lawrence Livermore Lab.). 8 May 1972. 10p. (CONF-720903-5). Dep. NTIS.

From twentieth remote systems technology conference; Idaho Falls, ID. (17 Sep 1972).

A family of one-foot-thick water shielded facilities was constructed to permit rapid, convenient manipulations on intensely alpha active materials. Although nominally a manipulator operated containment enclosure, each shield contains the feature of allowing gloved operations in the enclosure on demand with minimal expenditure of time or effort. The basic shield encloses a replaceable alpha confinement box and provides shielding on four faces of the box, the top and rear not being shielded. Rear shielding is provided by locating the units against a structural concrete wall or heavy cell wall. (auth)

46108 (UCRL-73757) CONTAMINATION CONTROL HARDWARE FOR REMOTE HOT CELL TRANSFERS. Coops, M. S.; Hanson, C. L.; Voegele, A. L. (California Univ., Livermore. Lawrence Livermore Lab.). 8 May 1972. 11p. (CONF-720903-2). Dep. NTIS.

From twentieth remote systems technology conference; Idaho Falls, ID. (17 Sep 1972).

Remotely-operated plastic-bag sealers have been installed in the Livermore Neutron Cells to minimize the spread of contamination during transfers of highly alpha contaminated materials from the confinement boxes to the underfloor transfer system. An in-cell welding system has been added to one of the rear cell areas to seal active waste materials into steel canisters to aid in meeting "special form" specifications. The operation of these devices is controlled remotely in the semi-automatic mode to increase the reliability of the welded seals. (auth)

46109 DOUBLE ELECTROMAGNETIC VALVE FOR SIMULTANEOUSLY CONTROLLING DANGEROUS FLUIDS AND VACUUMS. Fremion, Lucien (to Commissariat a l'Energie Atomique). French Patent 2,088,094. 7 Jan 1972. Filed 15 May 1970. (In French).

An electromagnetic valve intended for applications in conjunction with dangerous fluids (corrosive or radioactive) is described. The valve possesses a magnetic part, which is attracted by an excited electromagnet and shuts-off the flow by an axial displacement. Two different circuits can be simultaneously controlled: a circuit for the fluid to be processed and a circuit containing the processing atmosphere. The displacement of the magnetic part also controls the opening of the two circuits. This opening can be carried by remote control, contamination risks thus being avoided. (France)

46110 SAMPLE-CONVEYING MECHANISM FOR SCINTILLATION COUNTING. Scherzer, Walter O.; Thomas, Edward W. (to Beckmann Instruments, Inc.). U. S. Patent 3,663,816. 16 May 1972. Filed 20 May 1966.

A conveying mechanism for transporting a sample vial from an external loading platform into a light-tight counting chamber of a scintillation detector is described. The invention comprises a wall defining a counting chamber having an elongated passage, the wall

having a shoulder. A sample platform is also incorporated having an attached shaft to position the platform through the passage and into the counting chamber, and a sleeve movable about the shaft for engaging the shoulder to prevent external light from entering the counting chamber. (Official Gazette)

46111 EQUIPMENT FOR CONCENTRATING RADIOACTIVE SOLUTIONS. **Arnal, Thierry; Ganivet, Michel; Somon, Roland (to Commissariat a l'Energie Atomique). French Patent 2,081,129. 3 Dec 1971. Filed 6 Mar 1970. (In French).**

Equipment is described for concentrating (continuously) large volumes of radioactive solutions e.g., plutonium nitrate elution, oxalic mother liquor, and uraniferous effluents. A vertical axis cyclone is used to separate the liquid and vapor phases of the solution. The cyclone has an output for the liquid phase situated at its lower end, an output for the vapor phase situated at its upper end, and at least one input for the solution to be concentrated; this input consists of an admission tube tangentially joined to the wall of the cyclone. This tube is associated at the exterior to a heating and vaporization assembly. The equipment is also provided with a tube for evacuating the liquid phase, tubing for feeding the apparatus with the solution to be treated, this tubing being connected to the admission tube, a heat exchanger, and a device for estimating the position of the solution level in the cyclone. (France)

46112 PNEUMATIC MACHINE FOR THE REMOTE CONTROLLED SEALING OF FLASKS IN A SHIELDED CELL. **Cassimatis, Jean; Vie, Robert (to Commissariat a l'Energie Atomique). French Patent 2,088,806. 13 Dec 1971. Filed 24 Apr 1970. (In French).**

A pneumatic machine for the remote controlled sealing of flasks (in a shielded cell) using skirted supple plugs is described. The machine is provided with a receptacle for the flasks, which pivots about an axis and receives, at the appropriate moment, a flask with its plug. A hollow casing above the receptacle contains a series of pistons, fitted one into the other. A compressed air system, which is remotely controlled by a handle device, is used to advance these pistons towards the flask held in the receptacle or to recede them from it, and to ensure the sealing of the flasks. (France)

46113 HOLDER FOR RADIOACTIVE MATERIAL. **Glasser, Herman (to Nuclear Associates, Inc.). U. S. Patent 3,673,411. 27 Jun 1972. Filed 3 Mar 1970.**

A holder is described for radioactive material fabricated of high-density material to reduce transmission of energy, either by radiation or particle bombardment, either inwardly or outwardly thereof while yet enabling observation of material within an inner container or vial. (Official Gazette)

Transportation

46114 (MLM-1911) DOCUMENTATION OF DOT-SP-5915 FOR 55/30 AND 83/55 DRUM COMBINATION PACKAGING. **Madding, R. D. Jr.; Vallee, R. E.; Griffin, J. F. (Mound Lab., Miamisburg, Ohio). 28 Apr 1972. Contract AT-33-1-GEN-53. 45p. Dep. NTIS.**

A report is presented to make available to all potential users the technical information and limits pertinent to the construction and use of the 55/30 and 83/55 drum combination packages for which the Department of Transportation has issued special permit No. 5915. A complete physical and technical description of the packages is presented. The authorized packaging consists of either of two sizes of metal, drum-type "bird cage" packaging, for single trip use only. The Model 55/30 consists of a 55-gal outer drum and a 30-gal inner drum, and the Model 83/55 consists of an 83-gal outer drum and a 55-gal inner drum. For both models, the annular space between the drums is filled with moistened vermiculite. A nuclear criticality safety analysis is included. This analysis showed that for Fissile Class I packages, uranium-235, uranium-233, and plutonium-239 must not exceed 200, 190, and 175 g, respectively for container Model 83/55, and 180, 150, and 138 g, respectively, for container Model 55/30. Design and development considerations required for proof of the containers' ability to withstand a sequence of four hypothetical accident conditions are discussed. The four tests conducted in sequence on the same container were free drop, puncture, thermal, and water immersion tests. The tests showed that dampened vermiculite provided good insulation around the inner containers. It was calculated that no corrosion inhibitor was required in the damp vermiculite unless the containers were to be stored for long periods of time. Sponge rubber seals performed better than other gasket materials tested for the drums. In addition to the development data required for special permit No. 5915, data are presented pertaining to designs for disposable containers for radioactive sludge, for solid plutonium-238 compounds, and for radioactive gas. Test results on a design modification to the reusable DOT Specification 6M container are also reported. Tables, graphs, drawings, pictures, technical references, and a copy of permit DOT-SP-5915 are included. (auth)

46115 PACKAGING FOR RADIOACTIVE MATERIALS. **Blum, Paul (to Transnucleaire Societe pour les Transporte de l'Industrie Nucleaire). French Patent 2,088,028. 7 Jan 1972. Filed 8 May 1970. (In French).**

A packaging for radioactive materials emitting neutrons and producing heat is described. The packaging is characterized by the fact that good conducting metallic elements capable of absorbing neutrons and having a U or I shaped section, are buried in a bonding material provided in the space between the inside and the outer shell of the packaging. (France)

46116 SHIPPING CONTAINER FOR FISSILE MATERIAL **(25 May 1972) (Engineering Materials). (Dow Chemical Co., Denver, Colo. Rocky Flats Div.). (CAPE-1657).**

4 drawings.

This container may be used to ship up to 5 kg of ^{233}U or ^{239}Pu or 11 kg of ^{235}U. The container consists of a 30 gallon drum with vented lid, fiberboard insulation and a light-gage stainless steel containment vessel. (For details see TID-4100 Suppl. 72) (F.S.)

46117 TRANSPORT OF RADIOACTIVE MATERIALS BY RAIL.. **Scheefer, H. (Bundesbahn-Zentralamt, Minden, Ger.). Eisenbahn-Ing.; 22: No. 5, 141-4(1971). (In German).**

The regulations for the transport of radioactive materials are the same for transport by rail or road; they are based on the "Regulations for the Safe Transport of Radioactive Materials" (IAEA 1967). Their aim is to create a framework of generally accepted regulations and instructions for such transports in order to ensure that these transports differ as little as possible from that of other goods. The principle was to achieve this by the type of packing. (INIS)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstracts: 45432, 46146, and 46873.

46118 (KFKI-71-47) NEW 5 MeV VAN DE GRAAFF ION ACCELERATOR AT THE CENTRAL RESEARCH INSTITUTE FOR PHYSICS OF THE HUNGARIAN ACADEMY OF SCIENCES, BUDAPEST. Pasztor, E.; Kostka, P.; Klopfer, E.; Berecz, Gy.; Buerger, G.; Gombos, P.; Horvath, B.; Kiralyhidi, L.; Riedl, P. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). 1972. 122p. Dep. NTIS (U. S. Sales Only).

The new 5 MeV Van de Graaff ion accelerator designed and built at the Central Research Institute for Physics of the Hungarian Academy of Sciences and started in normal operation on March 12, 1970, is described. In its present state, the equipment is suitable for accelerating protons, deuterons and He_4^+ ions. Analyzed ion beams are of max 10 μA intensity and the stability of energy of ions is 1.5 to 2.5 10^{-4} at the target. Design is also described, main technical data are given, and special problems of the high-pressure gas insulation and the charging system are dealt with in detail. Original measuring results are given on the harmful effects of humidity and dust contents. The mechanical and electrical designs of the ion source and its auxiliary equipment are dealt with, technical data listed, and the system engineering is described. Technological and ion-optical development of the accelerator tube is outlined from a conventional homogeneous-field porcelain tube to a PVA-cemented inclined-field glass accelerator tube. Details of the ion-optical design, as well as conditioning and initial operation of the completed tube, are also discussed. Design of the complex energy stabilization system, the NMR fluxmeter developed in the Institute, and the impulse width modulated stabilization system of the magnetic field are also treated. Finally, experiences gained during 6,253 hours of operation completed so far are summed up. (auth)

46119 (LA-5000) ORIGINS AND HISTORY OF THE LOS ALAMOS MESON PHYSICS FACILITY. Livingston, M. Stanley (Los Alamos Scientific Lab., N. Mex.). Jun 1972. Contract W-7405-eng-36. 68p. Dep. NTIS.

A history of the Los Alamos Meson Physics Facility (LAMPF) from initiation of preliminary plans and proposals in 1962 to the present is presented. It includes the year-by-year story of the actions of the Atomic Energy Commission, the United States Congress, and the Bureau of the Budget relative to funding the project. It also discusses the discovery, subsequent interest, and proposed applications of the pi-meson. (auth)

46120 ELECTRON ACCELERATION IN AN ONDULATOR SYNCHROTRON. Ziyakaev, R. G.; Fomenko, G. P.; Chuchalin, I. P.; Yushkov, Yu. G. (Tomsk Polytechnic Inst., USSR). JETP Lett. (USSR) (Engl. Transl.); 15: No. 6, 212-13(20 Mar 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 6, 301-2(20 Mar 1972).

The 2-MeV electron ondulator synchrotron at Tomsk Polytechnic Institute is briefly described. The electrons are accelerated in a 10-cm-band resonator in which the H_{814} mode is excited. In each passage through the resonator, the electrons increase their energy by 350 keV at the maximum of the electric field and are then returned to the resonator at the next maximum of the electric field with the aid of electron-mirror turning magnets installed in line with the resonator. The output beam current is 50 mA, and the electron energy spread is 6%. (W.H.K.)

46121 DOSE ESTIMATES OUTSIDE THE SHIELDING OF THE CERN INTERSECTING STORAGE RINGS BY THE MOYER METHOD. Routti, Jorma T.; Van de Voorde, M. H. (CERN, Geneva). Nucl. Eng. Des.; 21: No. 3, 421-34(1972).

Formulas and results are presented for a convenient estimation of dose levels outside the transverse shielding of a high-energy proton accelerator. They are obtained by applying the Moyer method to uniform, local, and exponential beam-loss distributions. The techniques are used in shielding considerations of the CERN Intersecting Storage Rings. The layout of the main shielding is described, and estimates of the beam losses during various machine operations are summarized and used to evaluate doses outside the main shield. (8 figures, 2 tables) (auth)

46122 Q-VALUE EFFECTS OF ACCELERATING STRUCTURE IN TRAVELING-WAVE LINACS. Irie, Koichi (Mitsubishi Electric Corp., Amagasaki, Japan). Jap. J. Appl. Phys.; 11: No. 7, 1056(Jul 1972).

Quantitative evaluation of the Q-value effect on accelerator performance is important as it affects the cost of construction. The results of such effects on the electron energy of a traveling-wave linac are given. It is found that the Q-value of the accelerating structure has little effect on electron energy. What effect there is is less in the constant-gradient machine than the constant-impedance one. The smaller the total attenuation parameter, the smaller the effect. (1 figure) (R.W.R.)

46123 COMPUTERIZED CONTROL OF AN ACCELERATOR AND THE ASSOCIATED EXPERIMENTS. Bluet, J. C.; Fardeau, P.; Arnaud, A. (CEN de Cadarache, Saint-Paul-les-Durance, France). Bull. Inform. Sci. Tech. (Paris); No. 168, 88-90(Mar 1972). (In French).

The CII 90-10 computer associated with the Van de Graaff accelerator at Cadarache is described. This computer is programed in order to ensure the monitoring and possible energy adjustments of the accelerator. (France)

46124 ACCELERATION OF ARGON IONS TO 1.17 x 10^{10} ELECTRON VOLTS. Isaila, M. V. (Princeton Particle Accelerator, N. J.); Schimmerling, W.; Vosburgh, K. G.; (and others). Science; 177: No. 4047, 424-5(4 Aug 1972).

Argon ions were accelerated to 1.17 × 10^{10} electron volts in the Princeton Particle Accelerator. The synchrotron was tuned by use of a neon beam with a charge-to-mass ratio equal to that of the argon ions. The fully accelerated argon ions were detected by the observation of etched tracks in cellulose nitrate sheets and also by the use of scintillation counters. Predictions of the range and of the characteristics of argon tracks in plastics were confirmed. (auth)

46125 DIELECTRIC STRENGTH OF ACCELERATOR TUBES. Almazov, A. V.; Myntsov, F. F. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 6, 1619-22(1971).

Translated from Prib. Tekh. Eksp.; 14: No. 6, 32-5(1971).

The results of investigations of the influence of various factors on the dielectric strength of elements of accelerator tubes are expounded. It is shown that the greatest influence is produced by the quality of the contact between the dielectric and the electrodes. For a good contact the minimal strength of the elements in a vacuum for an element length of 25 mm is 44 kV/cm. (auth)

Auxiliaries and Components

46126 (ORNL-tr-2617) INTRANUCLEAR CASCADE IN THE CONCRETE SHIELD OF A 70-GeV PROTON SYNCHROTRON. Britvich, G. I.; Getmanov, V. B.; Lebedev, V. N.; Mal'kov, V. V.; Sychev, B. S. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). Translated for Oak Ridge National Lab., Tenn., from report IFVE-ORZ-71-81. 11p. Dep. NTIS.

The transport of the high energy component in a concrete shield in the neutral particle channel of the Serpukhov Synchrotron was studied. The internal target of the accelerator bombarded by protons of 70 GeV served as the radiation source using steel and concrete collimators. The neutral particles were magnetically separated from the charged particle background and were incident on the concrete block in which the hadron flux attenuation was studied. The density of the concrete was 2.3 to 2.35 g/cm^3. The beam profile at the point of incidence on the concrete block, the flux density distribution in the beam plane, and the flux density distribution in planes perpendicular to the beam axis are shown graphically. Also, the experimental data on the integrated transverse flux density distribution are compared with the calculated results of the internuclear cascade in iron. (W.H.K.)

46127 AUTOMATIC FREQUENCY CONTROL AGAINST TEMPERATURE CHANGE IN LINAC'S ACCELERATING STRUCTURE. Irie, Koichi (Mitsubishi Electric Corp., Amagasaki, Japan). Jap. J. Appl. Phys.; 11: No. 7, 1057(Jul 1972).

The phase slip resulting from temperature changes in the accelerating structure of an electron linac causes a reduction in energy gain. This is ordinarily prevented by two independent control systems, one regulating temperature and the other regulating microwave frequency. However, it is shown that regulation is sufficient if the microwave frequency follows the change of the resonant frequency of the structure due to temperature change, and a method to accomplish this type of control is proposed. (3 figures) (R.W.R.)

46128 COMPENSATED CURRENT-DRIVEN MAGNETIC CHANNEL IN A 240-cm ISOCHRONOUS CYCLOTRON. Belyakov, V. A.; Litunovskii, R. N.; Minyaev, O. A. (Electrophysical Equipment Research Inst., Leningrad). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 1, 154-6(Jul 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 1, 194-7(Jan 1972).

The basic theoretical and experimental characteristics of a compensated current-driven channel in the beam extraction system in the 240-cm isochronous cyclotron of the Institute of Nuclear Research, Academy of Sciences of the Ukrainian SSR (IYaI AN UkrSSR) are reported. The channel lowers the magnetic field to 2200 Oe, with a positive radial gradient to 150 Oe/cm, at roughly 80-kW power input. The amplitude of the first harmonic of the field disturbance introduced by the channel in the beam acceleration region is less than 10 Oe. (3 figures) (auth)

46129 MAGNETIC SHIELD FOR A 240-cm ISOCHRONOUS CYCLOTRON. Belyakov, V. A.; Vasil'ev, V. I.; Litunovskii, R. N.; Minyaev, O. A. (Electrophysical Equipment Research Inst., Leningrad). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 1, 157-9(Jul 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 1, 197-9(Jan 1972).

The basic experimental characteristics of the passive magnetic shield of the beam extraction system of the 240-cm isochronous cyclotron at the Nuclear Research Institute, Academy of Sciences of the Ukrainian SSR [IYaI AN UkrSSR] are given. The shielding factor in the working range of the externally applied magnetic field, 5000 to 7000 Oe, varies from 0.03 to 0.5. A positive radial field gradient of 350 Oe/cm is established by means of the cutoff angles on the channel ends and the variable internal aperture. The perturbations in the magnetic field in the beam acceleration zone due to this field are compensated to the level of several oersteds (first harmonic) with the aid of two pairs of iron shims. (3 figures, 2 tables) (auth)

46130 DIELECTRIC STRENGTH OF INSULATORS IN A VACUUM. Solodovnikov, A. P. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1156-7(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 176-7(Jul-Aug 1971).

The joining of insulators to electrodes and the choice of the method of treating their lateral surface are considered; application is made to the construction of accelerator tubes for electrostatic generators. (1 figure) (auth)

46131 CONTROL SYSTEM FOR BEAM FORMATION AFTER SINGLE DEFLECTION AT THE EXIT OF THE 300 MeV ELECTRON LINEAR ACCELERATOR. Egiyan, K. Sh.; Bochek, G. L.; Mocheshnikov, N. I.; Alanakyan, K. V.; Sitenko, M. L. (Inst. of Physics, Erevan. Physical-Technical Inst., Kharkov). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 6: No. 3, 214-18(1971). (In Russian).

The control system designed for beam formation after single deflection in the 300-MeV Kharkov linear accelerator is described. The principle of operation is based on a comparison of the intensities of the beam at two points (at the exit of the accelerator and immediately before the target of the experimental arrangement. (5 figures) (auth)

46132 IMPROVEMENT OF THE ELECTRON BEAM SHAPER OF THE B5M-25 MODEL BETATRON. Kozlov, A. P.; Shishov, V. A. (Leningrad Oncology Inst.). Med. Radiol.; 17: No. 5, 70-5 (May 1972). (In Russian).

An improved design of the B5M-25 betatron electron beam shaper is proposed. It enables creating uniform dose fields measuring 18×18 cm^2 with a variation factor not in excess of 10%. The use of the improved shaper enables the skin radiation load to be cut down by 15 to 20% by comparison with the former version, and also makes it possible to reduce appreciably the background radiation outside the radiation field. (5 figures) (auth)

Ion Sources, Injection, and Extraction

46133 PRODUCTION AND ACCELERATION OF MULTICHARGED IONS OF PHOSPHORUS AND ZINC. Pasyuk, A. S.; Tret'yakov, Yu. P.; Zager, B. A. At. Energ. (USSR); 32: No. 6, 505-8(Jun 1972). (In Russian).

Experiments were conducted for the purpose of developing ion sources in the solid phase for use in a cyclotron. A stainless steel crucible loaded with zinc or red phosphorus was protected by a heat shield during operation as an ion source. The technical grade of zinc yielded Zn^{10+}, Zn^{2+}, and other ions, and the Zn^{10+} ion current was investigated as a function of the pressure in the vacuum chamber. Zinc consumption was 0.035 g/hr. A charge spectrum of phosphorus ions showed the presence of P^+, P^{2+}, P^{3+}, P^{4+}, P^{5+}, and P^{6+}, in addition to oxygen ions. Phosphorus consumption was 0.13 g/hr. (3 figures) (K.S.W.)

46134 MULTIPACTORING ELECTRON GUN FOR HIGH DUTY LINACS. Liska, Donald J. (Los Alamos Scientific Lab., N. Mex.). Proc. IEEE (Inst. Elec. Electron. Eng.); 59: No. 8, 1253-4(Aug 1971).

A high duty factor electron gun suitable for linac applications is described. This gun operates on the secondary emission principle to generate a pulsed, monochromatic electron output beam in excess of 20 mA average current. It has been operated at 14 percent duty factor and shows a high degree of stability and ease of control. (auth)

46135 SEPARATE CONTROL OF THE INJECTOR HEATING AND OF THE CURRENT AMPLITUDE IN TRANSFORMER ACCELERATORS. Goncharov, N. F.; Egorov, A. A. (Inst. of Nuclear Physics, Novosibirsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 6, 1623-4(1971).

Translated from Prib. Tekh. Eksp.; 14: No. 6, 36-7(1971).

An automatic pulse network is described for separate control of the operating mode of two loads which are fed from a single source to a single transmission line. The loads differ in character: the operating modes of one of them is determined by the rms value of the source voltage; the operating mode of the other is determined by the amplitude value. A circuit is given for comparing the rms value with a reference voltage. The network described is used for separate control of the heater and the modulating-pulse amplitude for the injector in the ELIT transformer accelerator. (auth)

Ion Optics and Field Calculations

46136 (JINR-P9-6421) INFLUENCE OF THE ELECTROMAGNETIC PING ACCELERATION ON THE FOCUSING BY IMAGE FORCES. Zhabitskii, V. M.; Ivanov, I. N. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1972. 13p. (In Russian). Dep. NTIS (U. S. Sales Only).

The focusing of the accelerated electron ring by the image forces in a perfectly conducting cylindrical screen is considered. The corrections to the focusing force induced by the acceleration are found, and their influence is analyzed. (auth)

46137 (JINR-P9-6514) STABILITY OF THE SCREENED RING AT THE CENTER SHIFT. Zhabitskii, V. M.; Zolina, I. A.; Kaminskaya, A. M.; Ivanov, I. N.; Perel'shtein, E. A. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1972. 18p. (In Russian). Dep. NTIS (U. S. Sales Only).

The problem is considered on the electron ring stability when its center is shifted with respect to the axis of the screening tube. The particle motion in the shifted ring is analyzed. The limitations are found for the admissible deviations of the ring center depending on the system parameters. (auth)

46138 LINEAR STABILITY OF A CHARGED BEAM IN AN INDUCTION SYSTEM. Grishin, V. K. Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 1, 6-8(Jul 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 1, 9-12(Jan 1972).

The kinetic equation is used to study the longitudinal stability of a charged beam in a ferromagnetic channel. The growth rates of instabilities in high-current devices are estimated for the example of a linear induction accelerator. (auth)

46139 PARTICLE ACCELERATION IN A H_{111} CYLINDRICAL CAVITY IN AN AXIAL MAGNETIC FIELD. Gryzlov, A. V.; Panasyuk, V. S.; Ryzhkov, V. M.; Sokolov, A. A.; Tereshkin, Yu. M. Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 1, 9-13 (Jul 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 1, 13-18(Jan 1972).

Certain aspects of particle acceleration in the electric field of the H_{111} mode in a cylindrical cavity are discussed for the case of a pulsed magnetic drive field. The "resonant" time dependence is found for increasing magnetic field. The limiting energy is determined for particles accelerated by a homogeneous high-frequency electric field in a constant, homogeneous magnetic field. The maximum rate of rise of a linearly changing magnetic drive field is found. Acceleration rates are found for a linearly increasing magnetic field and for the "resonantly" increasing magnetic field. (3 figures) (auth)

46140 APPROXIMATIONS OF THE SPACE CHARGE FIELD FOR DIFFERENT BEAM SHAPES IN THE CENTRAL REGION OF A SYNCHROCYCLOTRON. Besnier, Gilbert; Thouroude, Daniel (Univ., Rennes, France). Compt. Rend., Ser. B; 274: No. 15, 927-30(10 Apr 1972). (In French).

The space charge field was calculated for two simple forms of the injected beam. It is assumed that the beam breaks away from the source in a charge sector (cyclotron phase) which generates a charge column in the azimuthal direction. (France)

46141 ORTHOGONALITY RELATIONS IN PERIODIC WAVEGUIDES HAVING ANISOTROPIC SURFACE IMPEDENCE. Garault, Yves; Jecko, Bernard (Univ., Limoges, France). Compt. Rend., Ser. B; 274: No. 12, 769-72(20 Mar 1972). (In French).

Iris-loaded rectangular periodic structures and circular periodic structures such as iris-loaded waveguides and shielded-ring lines are studied. The simultaneous excitation of two hybrid modes in one of these guides is considered. The waveguide is considered to be smooth with a uniform anisotropic surface joining the ends of the iris or rings. Calculations are simplified, only the fundamental mode of the electromagnetic field excited (in the coaxial region in the case of a ring line) is considered. The dependence of the field on z is demonstrated. The corresponding function is integrated over the cross section of the guide (of circular or rectangular cross section). This integral is demonstrated to be zero for all structures. (France)

46142 INSTABILITY OF AXIAL OSCILLATIONS IN AN ELECTRON-RING ACCELERATOR. Zenkevich, P. R.; Koshkarev, D. G.; Perel'shtein, E. A. At. Energ. (USSR); 33: No. 1, 567-71(Jul 1972). (In Russian).

The oscillations of an electron-ring column result in additional forces acting on the local center of gravity of the electrons owing to nonstationary charges and currents. Taking into account these forces, the authors consider the stability of an electron and electron–ion ring relative to lateral wriggles directed parallel to the ring axis. It is shown that in an electron ring there may arise a dipole axial instability related to the quasi-static and radiation fields of the electrons. Expressions are obtained for the increment and threshold of this instability in empty space and in a waveguide having longitudinal cuts. There is investigated the behavior of an electron–ion ring with the interaction forces between electrons and ions as well as the forces acting between electrons taken into account. It turns out that for a proper choice of ring parameters the presence of ions decreases the dipole instability increment of an electron-ring. (1 figure) (auth)

Storage Rings

Refer also to abstracts: 46121, 46426, and 46546.

46143 CERN PROTON STORAGE RING. Keil, E. (CERN, Geneva). Naturwissenschaften; 59: No. 5, 197-204(May 1972). (In German).

The interest in proton-proton colliding-beam storage rings is due to the fact that they allow the observation of the strong proton-proton interaction at much higher center-of-mass energies than conventional accelerators, and at similar counting rates. The CERN Intersecting Storage Rings (ISR) are described with particular emphasis given to the differences between storage rings and accelerators. The results of the first few months of commissioning are discussed in detail. Some space charge phenomena which limited the ISR performance have been eliminated; some others are still present. 40% of the design current, and 5% of the design luminosity have already been reached. (auth)

Experimental Facilities

Refer also to abstracts: 45638 and 46848.

46144 (CONF-720607-22) 150-METER TIME-OF-FLIGHT FACILITY AT ORELA. Silver, E. G.; Ingle, R. W.; de Saussure, G.; Perez, R. B.; Weaver, H.; Robson, R. J. (Oak Ridge National Lab., Tenn.). 1972. 4p. Dep. NTIS.

From eighteenth annual American Nuclear Society conference; Las Vegas, NV. (18 Jun 1972).

The modification of the ORELA neutron time-of-flight facility by increasing the flight path from 40 to 150 meters is described. The collimators added to the system are briefly described, and advantages of the increased flight path are discussed. The system employs an 800-gallon liquid scintillator gamma detector. (W.H.K.)

46145 DECREASE OF THE OFF-DUTY FACTOR IN THE OPERATION OF A LINEAR ACCELERATOR. Adeishvili, D. I.; Grishaev, I. A.; Mocheshnikov, N. I.; Tolstoi, A. E. At. Energ. (USSR); 33: No. 1, 593-4(Jul 1972). (In Russian).

The conversion of the pulsed electron beam of a linear electron accelerator into a continuous beam of photons by utilizing an internal target in a storage ring is described. The intensity and duration of the photon beam bremsstrahlung are capable of being varied within wide limits; and for target distances of 4, 8, and 16 mm from the equilibrium orbit the bremsstrahlung intensity was measured as a function of the relative spacing of the circulating beam and the target. (3 figures) (K.S.W.)

46146 CYCLOTRON LABORATORY AT THE TECHNICAL UNIVERSITY OF EINDHOVEN. Poppema, O. J. (Technische Hogeschool, Eindhoven, Netherlands); Verhaar, B. J.; Hagedoorn, H. L.; Bruininx, E. Ned. Tijdschr. Natuurk.; 37: 55-63(18 Feb 1971). (In Dutch).

A survey is given of the experimental and theoretical work at the Cyclotron laboratory of the Technical University of Eindhoven. Nuclear reactions are studied with beams of polarized protons and deuterons. Applied work is performed on elemental analysis by means of nuclear reactions, on production of radioisotopes and on the use of short-living nuclides in the study of gas discharge. A few remarks are made regarding the automatic regulation of the cyclotron with a POP-9 computer. (Netherlands)

46147 LINE-FOCUS ELECTRON BEAM LENS. Kalibjian, R. (Univ. of California, Livermore). Proc. IEEE (Inst. Elec. Electron. Eng.); 60: No. 2, 244(Feb 1972).

An electrostatic lens system has been developed to transform the circular beam from a conventional electron gun into a line-focus beam. The line-focus beam is uniform throughout its projected length on a phosphor screen. (auth)

46148 BETATRON BREMSSTRAHLUNG FOR PHYSICAL RESEARCH. Baciu, G. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 24: No. 1, 65-79(1972). (In Rumanian).

Nuclear research at the Bucharest betatron using bremsstrahlung beams is outlined. Topics include photoneutron reactions, the giant resonance, the dynamic collective nuclear model, photofission experiments, safeguards technology, nondestructive nuclear materials analysis, and other applications of the betatron in nuclear technology. (W.H.K.)

46149 INVESTIGATION OF POSITRON SPECTRA OBTAINED ON A LINEAR 8 TO 30 MeV ELECTRONIC ACCELERATOR. Tarutin, I. G.; Pilyavets, V. I. (Scientific-Research Inst. of Oncology and Medical Radiology, Minsk). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 6, 1625-8(1971).

Translated from Prib. Tekh. Eksp.; 14: No. 6, 38-40(1971).

The results are presented of investigations of the energy distribution of positrons which are formed in Ta conversion targets of 0.2, 0.5, and 0.8 radiation length units (X_0) thick. The dependence of the conversion coefficient at the maximum of the positron energy distribution on the energy of the incident electrons in the 12 to 30 MeV range were determined. It was shown that fluxes of positrons obtained on an LUÉ-25 linear electron accelerator amount to $\sim 10^7$ particles/sec. The optimal values of target thickness lie in the 0.7 to 0.9 X_0 range when the electrons incident on the converter have an energy of 25 to 30 MeV. A semi-empirical formula is derived for determining the yield of positrons having a stipulated energy as a function of the target thickness and the energy of the incident electrons. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstracts: 45215, 46219, 46257, and 46461.

46150 (NYO-3038-13) DETECTION OF LARGE COSMIC-RAY SHOWERS BY ATMOSPHERIC FLUORESCENCE. Final Report. Greisen, Kenneth (Cornell Univ., Ithaca, N. Y. Lab. of Nuclear Studies). 18 May 1972. Contract AT(30-1)-3038. 25p. Dep. NTIS.

Cosmic particles with energy on the order of 10^{20} eV arrive at the Earth with extremely low frequency, about one per square mile per decade. In 1962, a new experimental method was proposed to try to detect such particles with greater frequency by viewing them from afar (up to 20 miles from their path), using the fluorescent light emitted by some 10^{15} excited molecules along the path of such a particle and its progeny in the air. The proposed scheme also was expected to give new types of data by permitting each shower to be viewed throughout its history. In addition, its energy was to be directly measurable from the total number of molecules excited in the atmosphere. The direction of each shower relative to the stars would be revealed by the coordinates of the fluorescent light registered as a function of time. Initially, on the basis of previous reports on the fluorescent efficiency of air, the project looked easy; but when the spectrum and absolute yield of optical photons under fast particle bombardment of air were accurately measured it was found that the true yield was much smaller than anticipated. Still the project looked possible, though more difficult. In the years since 1963, several increasingly complex versions of optical detection systems have been set up on remote hilltop sites in the Ithaca area. With painstaking effort, they have been operated on many clear, moonless nights—while on many more nights the weather prevented operation. Marginal indications of possible showers were received, but no events stood out clearly enough from the background of starlight to permit unambiguous analysis as air showers. Each period of fruitless measurement was followed by study of weaknesses of the detection system and attempts to improve it. At one point a major change was initiated in which a detecting station was designed in the form of a "bug's-eye"; that is, hundreds of individual phototubes looking through large lenses at different parts of the sky. In addition to these efforts to improve the detector, other studies were made of the atmosphere. Among other minor projects, a way was developed of simulating showers by projecting a beamed pulse of light into the sky. The scattered light from the head of this beam is geometrically and kinematically like the source of light in an air shower, except for travelling upwards in time instead of downwards. Despite all these efforts, success was not achieved in development of a fruitful shower detector. In January 1972, the project was closed down. (auth)

46151 CHARGE COMPOSITION AND ENERGY SPECTRUM OF VERY HEAVY COSMIC RAYS. Fernandez, Joseph Ignatius. St. Louis; Washington Univ. (1971). 145p. University Microfilms Order No. 72-17,95.

Thesis.

A large area [0.92 m^2 steradian] electronic detector system for very heavy primary cosmic rays was flown on a high-altitude [~4.5 mg residual atmospheric pressure] balloon, from Sioux Falls, South Dakota in September 1970. The main elements of the detector were two pulse type gas filled ionization chambers and a Lucite Cherenkov counter. Measurements were made on the charge composition of VH [$20 \leq Z \leq 30$] and VVH [$Z \geq 30$] cosmic rays above 600 MeV/n and the energy spectrum of VH cosmic rays from 600 MeV/n to 1.28 GeV/n. In-flight calibration confirmed iron as the most abundant element in this region of the charge spectrum. (TSS) (Diss. Abstr. Int., B)

46152 SOLAR MODULATION OF GALACTIC PARTICLES. NUMERICAL INTEGRATION OF THE STEADY FOKKER-PLANCK EQUATION. Martinic, Nicolas J. Abstracts of Uppsala Dissertations from the Faculty of Science, No. 4. Uppsala; University of Uppsala (1972). 46p.

Thesis.

Galactic particles are modulated by the solar atmosphere showing, as a general feature, a decrease in the flux in $-\nu$. From numerical integration of the steady, spherically symmetric Fokker-Planck equation, which governs this phenomenon as a first approximation, it is shown that the galactic flux measured at the Earth presents the effect of: a) convection; b) diffusion; and c) adiabatic deceleration. The effect of convection is always a positive modulation at all kinetic energies (i.e. decrease of density of galactic particles vis-à-vis the galactic density), while the other type of modulation can be positive or negative depending on the particle's energies; pointing out that the integrated modulation due to adiabatic deceleration remains zero when all energies are taken into account. The density of galactic particles for a wide interval of energies (10^3 BeV to 10^{-3} BeV) is presented for all values of the radial distance in interplanetary space, whose range was taken 10 and/or 25 AU and for rigidity, kinetic energy, and total energy power laws, for protons; and the Webber law for electrons in the same range of energies. It is concluded that the proton spectrum presented in 1965 (Gloeckler and Jokipii, 1967) agrees fairly well with that calculated here when the galactic spectrum is assumed to be of the form E^{-7}, where E is the total energy of the protons. The electron spectrum presented in 1965–68 (Lezniak and Webber, 1971) shows the same topology as that calculated here. The effect of nongalactic sources which can be taken into the formalism is discussed. The numerical analysis, which is discussed in detail, follows the implicit scheme of the finite differences of the Fokker-Planck equation. (auth)

46153 ANGULAR DISTRIBUTION AND ENERGY SPECTRUM OF COSMIC-RAY SINGLE NEUTRONS WITH ENERGIES HIGHER THAN 5.10^{11} eV AT MOUNTAIN ALTITUDES. Babayan, Kh. P.; Boyadzhyan, N. G.; Mamidzhanyan, E. A. (Inst. of Physics, Erevan). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 6: No. 3, 168-73(1971). (In Russian).

The results of the study of single neutrons with energies higher than 5×10^{11} eV at mountain altitudes by means of an ionization calorimeter supplemented with proportional counters are given. The angular distribution and the integral energy spectrum of single neutrons were obtained. (4 figures, 1 table) (auth)

46154 GALACTIC GAMMA RADIATION BETWEEN 200 MeV AND 10 GeV. Bennett, K.; Penengo, P.; Rochester, G. K.; Sanderson, T. R.; Sood, R. K. (Imperial Coll. of Science and Tech., London). Nature (London); 238: No. 5358, 31-3(7 Jul 1972).

It is stated that it has not yet been established whether the γ radiation from the Galaxy at energies >100 MeV is a diffuse line flux from the galactic disk or arises from a number of weak point sources, and the production mechanism is poorly understood. In principle, the uncertainty about the production mechanism could be resolved by examining the energy spectrum of the γ rays with high-angular-resolution detectors, and a study is described of the high-energy part of the spectrum between 200 MeV and 10 GeV, using balloon-borne detectors together with a spark chamber. Details are given of the techniques employed. The experiment was flown from Lusaka in Zambia on Jan. 25 and Feb 9, 1971. The sky map obtained was scanned for possible point sources, and only one position suggested evidence for a source; there was, however, an apparent line flux from the galactic disk above the expected count rate. The data obtained provided evidence for the existence of a galactic line source of high-energy γ rays in the region of the galactic center. (UK)

46155 $^{37}Ar/^{39}Ar$ ACTIVITY RATIOS IN METEORITES AND THE SPATIAL CONSTANCY OF THE COSMIC RADIATION. Begemann, F. (Max-Planck-Institut fuer Chemie, Mainz). J. Geophys. Res.; 77: No. 20, 3650-9(10 Jul 1972).

Argon 37 and argon 39 were measured in a bulk sample and a metal-rich fraction of the Lost City stone meteorite. In the bulk sample the activity of both isotopes was in fair agreement with the activities reported previously for this meteorite. The activities calculated for the pure metal phase ($^{37}Ar = 15.1 \pm 2.5$ dpm/kg, $^{39}Ar = 20.0 \pm 1.5$ dpm/kg), however, were different. In particular, the activity ratio of 0.75 ± 0.10 was considerably higher than the previously published values. Consequently the radial heliocentric gradient of the galactic cosmic radiation was found to be much smaller. The data available for the activity ratios in the metal of different meteorites are discussed. Because the wide scatter in the ratios observed in meteorites that fell at comparable times during the solar cycle is due to different decay rates of ^{37}Ar, it is argued that at least during solar maximum the ratios depend essentially on the perihelions of the meteoroid orbits and on whether the meteorites fall on Earth when they are on their inward-bound trip or when they are going out. Except in special cases like Lost City, different aphelions will have a noticeable influence only for meteorites falling near solar minimum, provided that the spatial gradient of the cosmic-ray intensity is small or zero at solar minimum. (auth)

46156 HEAVY-ION RADIATION STUDIES IN TERRESTRIAL AND EXTRATERRESTRIAL MATERIALS. Seitz, Martin George.

St. Louis; Washington Univ. (1972). 132p. University Microfilms Order No. 72-17,959.

Thesis.

Analysis of radiation effects is undertaken to identify changes from solar and galactic radiation that might be expected in extraterrestrial samples. X-ray observations reveal macroscopic crystal distortion in terrestrial samples of pyroxenes, feldspars, quartz, apatite, epidote, and muscovite irradiated with 10.4-MeV/amu argon ions to doses of 2.0×10^{13} cm^2. No distortion is seen in olivine. The distortion occurs to a lesser degree with 10.4-MeV/amu neon and not at all with 7-MeV/amu helium irradiations to doses of 4.0×10^{13} and 9×10^{15} ions/cm^2, respectively. The distortion increases with decreasing energy of the irradiation, and, at any energy, is proportional to dose. Using a model of crystal distortion, the experimental results are better explained by the damage being proportional to the primary rate of ionization of the incident ions rather than to the number of displacements produced by close nuclear encounters. Some irradiated minerals show lattice-parameter changes. Sometimes, crystal fracturing results from severe distortion or from strain caused by the ions that have come to rest in the minerals. The minerals show different sensitivities to radiation and are classified accordingly. Except for fracturing, radiation effects recover by annealing. Both lunar and meteoritic materials show crystal distortion similar to that produced by heavy-ion irradiations. However, the distortion does not anneal, demonstrating that it is not of radiation origin. The other radiation effects are not observed in any of the lunar materials, including the very fine material (~20 microns) of the lunar soil where the largest radiation effects are expected. This lack of pronounced radiation effects is consistent with current ideas of the radiation history of lunar and meteoritic materials. In the second part of the thesis (fission tracks in lunar samples), apatite, whitlockite, and zircon appear to be of equal importance as uranium sources in the heterogeneous rock 12013. A new titanium–zirconium phase is estimated to contain about 10% of the rock's uranium. The more chemically equilibrated rock 12040 has about 80% of the uranium in whitlockite. Baddeleyite and the new zirconium–titanium phase contain most of the remaining uranium. The potassium-rich residual liquids of rock 12040, with ~7 ppM uranium, contain most of the uranium-bearing grains; thus the well-defined potassium uranium correlation in whole lunar rocks is valid for 12040 on a microscopic scale as well. Thorium–uranium ratios in minerals of 12013 range from 0.2 to 20 while whitlockites of 12040 have thorium–uranium ratios near 3.7, close to the natural abundance ratio. If plutonium acts chemically like thorium, some previously measured plutonium–uranium ratios for the early solar nebula may be too high. Fossil-track densities in whitlockite of four lunar rocks are found to be higher than expected from primary cosmic rays and spontaneous fission of uranium. Proton irradiations at 28 GeV show that the excess tracks are accountable for from high-energy spallation products. Plastic replicas of the fossil densities are able to isolate primary cosmic rays and fission tracks and allow fission-track dating. This dating technique promises to be an important tool for the search for exotic rock fragments of the lunar soil. (Diss. Abstr. Int., B)

46157 STOPPING PARTICLES UNDERGROUND. Grupen, C.; Wolfendale, A. W.; Young, E. C. M. (Univ. of Durham, Eng.). Nuovo Cim.; 10B: No. 1, 144-54(11 Jul 972).

An attempt was made to interpret the experimental results on stopping muons underground, which appear to show an anomalously high stopping rate, in terms of atmospheric muons, muons from the decay of locally produced pions, and muons from neutrino interactions. The results of calculations of the various contributions are given and the necessary corrections to the experimental data are discussed. It is shown that the experimental results are in reasonable agreement with the expected contributions from the various sources and that no new process is required. (auth)

46158 DIURNAL EFFECT OF THE COSMIC RAYS DURING THE PERIOD 15 OCTOBER 1965–30 JUNE 1966. II. THE EQUATORIAL COSMIC-RAY ANISOTROPY AND THE INTERPLANETARY MAGNETIC FIELD. Bussoletti, E.; Iucci, N. (Univ., Rome). Nuovo Cim.; 10B: No. 1, 56-65(11 Jul 1972).

Using the values of the "diurnal variation waves", obtained with the method described in Part I, possible correlations between the parameters of the interplanetary magnetic field B and the equatorial cosmic-ray anisotropy in periods of magnetically quiet space were studied. Attention was mostly devoted to the study of the morphology of the diurnal variation connected with the evolving "sector" structure of interplanetary space. Rather big differences from the results obtained in the December 1963–February 1964 period were found. This discrepancy can be attributed to the different phase of the solar activity. (auth)

46159 DIURNAL EFFECT OF THE COSMIC RAYS DURING THE PERIOD 15 OCTOBER 1965–30 JUNE 1966. I. METHOD OF ANALYSIS AND STATISTICAL DISTRIBUTION. Bussoletti, E.; Iucci, N.; Villoresi, G. (Univ., Rome). Nuovo Cim.; 10B: No. 1, 43-55(11 Jul 1972).

An improved method of analysis of the diurnal variation of cosmic rays has been developed starting from the one presented by Bachelet et al (1968). Instead of the usual numerical filtering techniques the properties of the asymptotic cones of acceptance of high-latitude cosmic-ray stations were used. Then all the results were collected into a matrix which could give a compact view of the equatorial anisotropy on an hourly basis. Because of the lack of stations in the Asiatic and Pacific area, the study was limited to an "average diurnal variation wave". The statistical distribution of daily values of both amplitudes and phases was analyzed. They agreed with the preceding results of various authors, and also showed an unexpected trend for the direction of the minimum for days with half-peak amplitudes of the anisotropy less than or equal to 0.5%. A preliminary investigation of the north–south anisotropy during Forbush decreases was also done. (auth)

Stars

Refer also to abstracts: 46212, 46466, and 46749.

46160 CORE OF ETA CARINAE. Gehrz, R. D.; Ney, E. P. (Univ. of Minnesota, Minneapolis). Sky Telesc.; 44: No. 1, 4-5(Jul 1972).

The 60-inch telescope at Cerro Tolalo was used to obtain a series of high-quality exposures of Eta Carinae on high-speed Ektachrome (ASA-160) color film. An isophate representation was constructed in which structures visible in the Gaviola chart (1950) were identifiable. The two condensations in Thackeray's (1949) elliptical ring were clearly seen. The velocities of the knots and distance were derived. (W.D.M.)

46161 RELATIVISTIC VELOCITY-POTENTIAL HYDRODYNAMICS AND STELLAR STABILITY. Schutz, Bernard Frederick Jr. Pasadena, Calif.; California Inst. of Tech. (1972). 188p. University Microfilms Order No. 72-17,650.

Thesis.

The equations of relativistic, perfect-fluid hydrodynamics are considered in Eulerian form using six scalar "velocity-potential" fields, each of which has an equation of evolution. These equations determine the motion of the fluid. Einstein's equations and the velocity-potential hydrodynamical equations follow from a variational principle. These equations are also cast into Hamiltonian form, with Hamiltonian density $-T^0_0(-g^{\infty})^{-\frac{1}{2}}$. The second variation of the action is used as the Lagrangian governing the evolution of small perturbations of differentially rotating stellar models. In Newtonian gravity this leads to linear dynamical stability criteria already known. In general relativity it leads to a new sufficient condition for the stability of such models against arbitrary perturbations. By introducing three scalar fields the Newtonian stability criteria are greatly simplified for the purpose of practical applications. The relativistic stability criterion is not yet in a form that permits practical calculations, but ways to place it in such a form are discussed. (Diss. Abstr. Int., B)

46162 INTERPRETATION OF THE NEUTRAL HELIUM TRIPLET SPECTRUM IN PLANETARY NEBULAE. Persson, Sven Eric. Pasadena, Calif.; California Inst. of Tech. (1972). 184p. University Microfilms Order No. 72-17,648.

Thesis.

The theory of the He I triplet spectrum is modified to include the effects of solid particles within the ionized regions of planetary nebulae. New observations of the emission lines λλ5876, 7065, and 10830 are presented for over twenty nebulae, extending the list of objects studied previously by O'Dell. The empirical ratios $R_1 \equiv I(\lambda 10830)/I(\lambda 5876)$ and $R_2 \equiv I(\lambda 7065)/I(\lambda 5876)$ are combined with the theory to study the discrepancies between the He I 2^3S depopulation rates D_1 (derived from R_1), D_2 (from R_2), and D_t (theoretical). If the presence of dust is neglected, the discrepancies are such that $D_1 > D_t > D_2$, in most cases. This is essentially the result found earlier by Capriotti for a smaller sample of objects. Estimates of τ_d (λ10830), the λ10830 dust optical depths which force $D_1 = D_t$, are derived by accounting for the resonance trapping and dust absorption of the λ10830 radiation. These estimates are consistent, on an order-of-magnitude basis, with values implied by observed infrared excesses in planetary nebulae, and by simple models of reradiating dust shells. The important effects of nebular structural features upon the He I triplet spectrum are studied theoretically and observationally. Overall correlations be-

tween the apparent 2^3S depopulation rate discrepancies and nebular parameters are shown to have a connection with a wide range of nebular problems. (Diss. Abstr. Int., B)

46163 VISCOUS EFFECTS IN RAPIDLY ROTATING STARS WITH APPLICATION TO WHITE-DWARF MODELS. Durisen, Richard Henry. Princeton, N. J.; Princeton Univ. (1971). 84p. University Microfilms Order No. 72-18,767.

Thesis.

Methods were developed for constructing viscous evolutionary sequences of barytropic equilibrium configurations with particular application to differentially rotating zero-temperature white-dwarf models. Contributions to the viscosity due to both ions and electrons are discussed. Such sequences were constructed using degenerate electron viscosity. For $M \gtrsim 1.4M_\odot$ and $Z = 7$, single timesteps typically show viscous time scales $\sim 10^7$ to 10^9 years, luminosities $\sim 10^1$ to 10^{-1} $L_\odot$ and effective temperatures $\sim$ 100,000 to 25,000°K respectively. For $Z \gtrsim 10$, ion viscosity probably becomes important for all masses, resulting in shortened time scales. Extensive evolutions show that some stars do not approach uniform rotation. The central density for stars with $M \gtrsim 1.5M_\odot$ increases without limit and may even diverge in a finite time, suggesting a Type-I supernova theory. (Diss. Abstr. Int., B)

46164 TYPE A STARS IN THE URSA MAJOR STREAM. Latyshev, I. N. (Leningrad State Univ.). Sov. Astron. AJ (Engl. Transl.); 15: No. 6, 1010-17(May 1972).

Translated from Astron. Zh.; 48: No. 6, 1269-79(Nov 1971).

The existence of the Ursa Major stream was investigated on the basis of the radial velocities and proper motions of type A stars brighter than 6m, following a method developed by the author. About 80 of the 1036 stars considered do belong to the stream. (auth)

46165 GUM NEBULA. de Latil, Pierre. Sci. Avenir; No. 303, 362-9(May 1972). (In French).

After a brief review of the different stages of the discovery of the Gum Nebula and its characteristics, hypotheses currently made about its origin and evolution are presented. (France)

46166 BIRTH OF STARS. Bok, Bart J. Sci. Amer.; 227: No. 2, 48-61(Aug 1972).

The general scheme developed here is one favoring the formation of protostars through the process of gravitational collapse in clouds of interstellar gas and dust. The author points out that it seems quite natural that star birth should be occurring now in the spiral arms of the Milky Way and of neighboring galaxies. Many dark nebulas and globules composed of interstellar gas and dust are seen almost in the act of collapsing into protostars or their close relatives. Objects that are either protostars or very young stars have also been observed. Infrared objects provide a natural link between small dark clouds and relatively normal stars; they may be cool, dense dust clouds with a star or cluster of stars near the center. The cocoon nebulas may also supply newborn stars. The T Tauri stars seem to be the next stage and help bridge the gap between the protostars and the young stars. (L.M.T.)

46167 ANGULAR MOMENTUM LOSS FROM CONTACT BINARY SYSTEMS. Moss, D. L. (Univ. of Manchester, Eng.). Mon. Notic. Roy. Astron. Soc.; 157: No. 4, 433-41(1972).

The effect of angular momentum loss on zero-age main sequence contact binary systems constructed according to the Lucy model was investigated. It was found that the separation of the mass centers decreases, the mass ratio decreases, and the system adopts a dumb-bell configuration. If the system reaches a configuration in which it fills its outer closed common equipotential surface it is unstable to mass loss with the local angular momentum through the outer Lagrange point. (auth)

46168 PHOTOELECTRIC MEASUREMENTS OF THE 6284 A DIFFUSE INTERSTELLAR LINE. Murdin, Paul (Royal Greenwich Observatory, Hailsham, Eng.). Mon. Notic. Roy. Astron. Soc.; 157: No. 4, 461-75(1972).

A photoelectric index of the λ6284 diffuse interstellar line was observed in 48 stars. It is shown that this line is probably exactly correlated with the line at λ4430. There are galactic variations in the ratio of λ6284 to interstellar reddening, correlated with similar variations of λ4430 to reddening. There is no clear evidence whether these variations are correlated with variations of the ratio of total-to-selective absorption. (auth)

46169 INFLUENCE OF LOCAL CONDITIONS IN THE INTERSTELLAR MEDIUM UPON STAR FORMATION. Hunter, James H. (Univ. of South Florida, Tampa). Mon. Notic. Roy. Astron. Soc.; 157: No. 4, 17P-19P(1972).

The gravitational stability of a spherical cloud surrounding a stellar core in the interstellar medium is discussed utilizing a modified form of the virial theorem. It is argued that the masses of the circumstellar shells surrounding most infrared objects should not exceed $\sim 10^{-2}$ $M_\odot$. (auth)

46170 WHITE DWARFS AND NEUTRON STARS. Sutherland, Peter Gordon. Urbana, Ill.; Univ. of Illinois (1972). 148p. University Microfilms Order No. 72-19,943.

Thesis.

The equation of state of zero-temperature matter in complete nuclear equilibrium is given for mass densities below 5×10^{14} g/cm^3. Taking into account the effect of the Coulomb lattice and using more recent nuclear mass extrapolations, the sequence of equilibrium nuclides present at mass densities between 10^4 g/cm^3 and 4.3×10^{11} g/cm^3 was redetermined, the point of neutron drip; and the equation of state was calculated. For densities between 4.3×10^{11} g/cm^3 and 5×10^{14} g/cm^3 the equation of state was taken from the calculations of Baym, Bethe, and Pethick; included were extensions of the equation of state to still higher densities, taken from the calculations of Pandharipande, which include the effects of hyperons. Zero-temperature white dwarf and neutron star models were calculated for the equation of state. The maximum stable white dwarf mass, the Chandrasekhar limit, was 1.00 $M_\odot$. The lightest stable neutron star has a mass 0.0925 $M_\odot$ and a central intensity of 1.55×10^{14} g/cm^3; neutron stars between 9.0925 $M_\odot$ and 0.11 $M_\odot$ are entirely solid. Moments of inertia, surface deformations and mass quadrupole moments were calculated for slowly rotating neutron stars. Some of the effects of strong magnetic fields (B in the range 10^4 to 10^8 gauss) on the line spectra and polarization of light from white dwarfs are discussed. Exact formulae for line centers and rms widths for the Balmer series in hydrogen are given, neglecting mixing between states of different principal quantum numbers. The range of validity of this approximation and deviations from the Van Vleck and Schiff–Snyder formulae are discussed. A general framework for discussing the origin of the polarization of light from white dwarfs is described and the polarization features produced by the hydrogen bound-free opacity are considered within this framework. The consequences of these calculations for the interpretation of white dwarf spectra are discussed. (Diss. Abstr. Int., B)

46171 INTERSTELLAR DUST AND DISTANCES TO PLANETARY NEBULAE. Lutz, Julie Haynes. Urbana, Ill.; Univ. of Illinois (1972). 108p. University Microfilms Order No. 72-19,872.

Thesis.

UBV and H_γ data were used to construct diagrams of color excess versus distance for early-type stars within 1.5° of eight planetary nebulae. These diagrams and the observed extinctions of the planetaries were used to derive distances for six of these nebulae. The diagrams were also used in conjunction with Cahn and Kaler (Astrophys. J. Suppl., 22, 319, 1971) distances for the program nebulae to derive a value of R, the ratio of total to selective absorption in the visual region, for the line of sight to each nebula. (Diss. Abstr. Int., B)

46172 CONVECTION IN STELLAR ATMOSPHERES. Travis, Larry Dean. University Park, Pa.; Pennsylvania State Univ. (1971). 220p. University Microfilms Order No. 72-19,393.

Thesis.

A survey of the principal theories of convection in stellar atmospheres was made for purposes of comparison as well as detailed examination of the deficiencies in the theories and numerical procedures. Since one of the major problems encountered was the instability of the standard model iteration techniques when convection was included, an improved iterative procedure was developed. This procedure, a linear relaxation method similar to that employed by Auer and Mihalas (1970 M. N., 149, 65) for non-LTE model calculations, has an advantage of extreme flexibility in that it can be applied to nearly any formalism for including convection. (TSS) (Diss. Abstr. Int., B)

46173 EQUILIBRIUM STRUCTURE OF CLOSE BINARY STARS. Naylor, Mark Dennis Thomson. Toronto; Univ. of Toronto (1971). National Library of Canada, Ottawa.

Thesis.

Two hundred and forty-five interior models were obtained for uniformly rotating synchronous close binary systems, using a modified double-approximation technique. Primaries of 10, 5, and 2 $M_\odot$ with mass ratios of 0.0 to 1.0 in steps of 0.1 were considered, and a primary of 1 $M_\odot$ with a mass ratio of unity for the case of small to moderate distortion was studied. (TSS) (Diss. Abstr. Int., B)

46174 TEN-MICRON SPECTROSCOPY OF CIRCUMSTELLAR SHELLS. Gammon, R. H.; Gaustad, J. E.; Treffers, R. R. (Univ.

of California, Berkeley). Astrophys. J.; 175: No. 3, 687-91(1 Aug 1972).

The infrared spectra of several stars with 10-μ "silicate" excesses were observed at high resolution ($\Delta\nu = 4$ cm^{-1}). A broad emission feature extending from 850 to 1100 cm^{-1} was found, but no fine structure was seen. The excess was consistent with radiation from dust composed of basic silicates but not with that from acidic minerals such as quartz. (auth)

46175 OBSERVATIONS OF PLANETARY NEBULAE AT 1.65 TO 3.4 MICRONS. Willner, S. P. (Smithsonian Astrophysical Observatory, Cambridge, Mass. Harvard Coll. Observatory, Cambridge, Mass.); Becklin, E. E.; Visvanathan, N. Astrophys. J.; 175: No. 3, 699-706(1 Aug 1972).

Photometric measurements at 2.2 μ of 15 planetary nebulae are presented, along with measurements of 12 at 1.65 μ and seven at 3.4 μ. The measurements agree with the predicted thermal emission from ionized hydrogen and helium except for four nebulae. IC 418 and BD + 30°3639 are brighter than predicted at all three wavelengths, and NGC 40 shows excesses at 1.65 and 2.2 μ, but was not measured at 3.4 μ. NGC 7027 shows an excess only at 3.4 μ. All the excesses are interpreted in terms of emission from dust distributed throughout or surrounding the nebulae. Dust temperatures as high as 1000°K are needed to explain the excess at 1.65 μ. (auth)

46176 STUDIES OF HYDRODYNAMIC EVENTS IN STELLAR EVOLUTION. II. DYNAMIC INSTABILITIES IN STELLAR ENVELOPES. Sparks, Warren M. (Goddard Space Flight Center, Greenbelt, Md.); Kutter, G. S. Astrophys. J.; 175: No. 3, 707-15 (1 Aug 1972).

For an evolved red giant of 1.1 $M_\odot$ (He and heavy-element core of 1.0 $M_\odot$, H-rich envelope of 0.1 $M_\odot$) the dynamic instabilities that result when the luminosity exceeds the limiting value L_0 for a static envelope were investigated. Assuming a constant opacity, $L_0 \simeq 10^{3.3}[(M/M_\odot)/\kappa]\ L_\odot$. When $L > L_0$, the H-rich envelope expands and detaches itself as a shell from the stellar core with final velocities of a few km s^{-1} and rates of mass flow of 10^{-5} to 10^{-4} $M_\odot$ year^{-1}. There exists an infrared phase which lasts until the entire escaping envelope is optically thin and becomes heated by the ultraviolet radiation from the stellar remnant. If T- and ρ-dependent opacities were used, the value of L_0 would increase somewhat and the ejection of the H-rich envelope would be preceded by pulsation. These instabilities may be responsible for the pulsation of long-period variables, the ejection of planetary nebulae, and the formation of certain infrared objects. (auth)

46177 RED SUPERGIANTS AND NEUTRINO EMISSION. II. Stothers, Richard (Goddard Space Flight Center, New York). Astrophys. J.; 175: No. 3, 717-30(1 Aug 1972).

The variation with stellar mass of the ratio of the numbers of blue and red supergiants was investigated. Statistical data for supergiants in young open clusters and subgroups of associations were collected to supplement a more restricted list in Paper I. Improved methods were used to identify hydrogen-burning supergiants, as well as faint supergiant remnants of binary mass exchange, and to arrange the bright evolved supergiants in order of their masses. Neither of these two operations requires knowledge of stellar distances or luminosities. Relevant published work on stellar evolution, rotation, mass loss, and duplicity was used to predict upper and lower limits on the blue-to-red ratio. It was concluded that (1) the observed paucity of very massive red supergiants (and of carbon stars) confirms and extends the trend observed in Paper I, and thereby supports the idea of neutrino-induced acceleration of the carbon-burning and later phases of evolution; (2) the h and χ Persei association shows the same dependence of the blue-to-red ratio on stellar mass as do other clusters and associations; and (3) a moderate decrease of the blue-to-red ratio is observed with increasing galactocentric distance in the Galaxy (as in M33) and seems to be due to a relative scarcity of extremely young stars in distant galactic regions. (129 references) (auth)

46178 HYDROSTATIC OXYGEN BURNING IN STARS. II. OXYGEN BURNING AT BALANCED POWER. Woosley, S. E.; Arnett, W. David; Clayton, Donald D. (Inst. of Theoretical Astronomy, Cambridge, Eng. Rice Univ., Houston, Tex.). Astrophys. J.; 175: No. 3, 731-49(1 Aug 1972).

The nucleosynthesis that occurs during hydrostatic oxygen burning in a "typical" stellar zone was examined in detail under the assumption that such stellar zones are in an approximate state of balanced power from $^{16}O + {}^{16}O$ energy generation and from neutrino (or photon) energy loss. Special attention was paid to the amount of neutron enrichment that occurs and the implications for nucleosynthesis theory. Accuracy of a common approximation for $^{16}O + {}^{16}O$ energy generation is discussed also. Theoretical models which assume the existence of a direct $e-\nu$ coupling in the weak interaction give results that are more consistent with current ideas regarding stellar nucleosynthesis than models which do not. (auth)

46179 STELLAR REACTION RATES FOR THE $^{12}C + {}^{12}C$, $^{12}C + {}^{16}O$, AND $^{16}O + {}^{16}O$ REACTIONS. Michaud, Georges (Univ. of Montreal). Astrophys. J.; 175: No. 3, 751-6(1 Aug 1972).

Thermonuclear reaction rates were calculated for the $^{12}C + {}^{12}C$, $^{12}C + {}^{16}O$, and $^{16}O + {}^{16}O$ reactions using optical models for the extrapolation from the recent measurements. At $T_9 \leq 0.7$ the thermonuclear reaction rate for $^{12}C + {}^{12}C$ is larger than that of Patterson, Winkler, and Zaidins by a factor of 10 but uncertain by a factor of 4. (auth)

46180 OBSERVATIONS OF THE He II λ10124 LINE IN O AND Of STARS. Mihalas, Dimitri (National Center for Atmospheric Research, Boulder, Colo.); Lockwood, G. W. Astrophys. J.; 175: No. 3, 757-64(1 Aug 1972).

Observed equivalent widths of He II λ10124 in absorption-line O stars are found to be in agreement with non-LTE computations assuming no overlap of H and He II lines, and in disagreement with the predictions of LTE and of non-LTE calculations assuming exact coincidence of even–even He II lines and the corresponding hydrogen lines. It is therefore inferred that pumping of He II transitions by H lines does not actually occur in the O stars. The discovery of the λ10124 line in emission in ζ Pup (O5f) argues further in this direction; and with the often-cited selectivity of the He II emission mechanism now much weakened, it is suggested that the causes of the emission must involve chromospheric phenomena. Analysis of source–sink terms in equivalent-two-level-atom source functions suggests trends that are compatible with the observed behavior of various lines. (auth)

46181 METALLICISM IN BORDER REGIONS OF THE Am DOMAIN. I. EXTREMELY YOUNG Am STARS IN THE ORION 1c ASSOCIATION. Smith, Myron A. (Univ. of California, Santa Cruz). Astrophys. J.; 175: No. 3, 765-77(1 Aug 1972).

A search for metallic-line stars by means of 127 and 63 Å mm^{-1} spectrograms and uvby photometry resulted in the discovery of five such stars in the extremely young Orion 1c association. A number of arguments in favor of their membership are made. It appears that Am stars in the pre-main-sequence-contraction phase occupy the same domain of the H–R diagram as do evolving Am stars. From the general properties of these stars it is concluded that the Am mechanism becomes operative and stabilizes within about 10^6 years. Evidence is also presented that in open clusters the characteristic rotation of stars, and not age directly, is important in determining the probability that an A star will become metallic lined. These conclusions are in best accord with an interpretation of metallicism in terms of subsurface diffusion. (auth)

46182 ROTATIONAL VELOCITIES OF Ap STARS. Abt, Helmut A.; Chaffee, Frederic H.; Suffolk, Graham (Kitt Peak National Observatory, Tucson, Ariz.). Astrophys. J.; 175: No. 3, 779-85(1 Aug 1972).

Projected rotational velocities were measured on coudé spectra for essentially all the northern bright Ap stars. Differences in these rotational velocities between subgroups are found to be marginal, except that Guthrie's discovery of a deficiency of very narrow-lined Si stars is confirmed. Ap stars have one-quarter the mean projected rotational velocity of normal stars of the same types and luminosities, but it is likely that a low rotational velocity is an insufficient criterion to produce a peculiar spectrum. Ap stars cannot be explained simply by an aspect effect. A comparison of projected rotational velocities with equatorial rotational velocities computed from periods of variations in light, magnetic field, or spectrum leads to evidence for random orientations of rotational axes. (auth)

46183 LUMINOSITIES AND MOTIONS OF THE F-TYPE STARS. II. METAL-DEFICIENT STARS. Eggen, O. J. (Australian National Univ., Canberra). Astrophys. J.; 175: No. 3, 787-807(1 Aug 1972).

An improved method of computing luminosities of F- and early G-type metal deficient stars from intermediate-band photometry is applied to the available photometry for some 250 objects with $\Delta[m_1] > +0.025$, including all of those brighter than visual magnitude 6.5 for which accurate apparent motions are available. Twenty halo stars, for which $\Delta[m_1] > +0.080$, are included. The distribution of the resulting space motions is in excellent agreement with that found from previous studies, based on UBV photometry, and used in discussing the dynamics of a collapsing galaxy. (auth)

46184 PRELIMINARY ANALYSIS OF THE ATMOSPHERIC ECLIPSE OF 32 CYGNI. Galatola, Anthony (La Salle Coll., Philadelphia). Astrophys. J.; 175: No. 3, 809-18(1 Aug 1972).

The blue and ultraviolet light curves of 32 Cygni were analyzed by using as a model an opaque core surrounded by a semitransparent envelope. The effects of the atmospheric eclipse were removed from the light curve to obtain a light curve of the body eclipse. In order to get a solution the body eclipse was assumed to be total. This led to an orbital inclination of 82° and 1.87 $R_\odot$ for the radius of the B star. The radius of the K star was 120 $R_\odot$ in blue light and 123 $R_\odot$ in ultraviolet light. It was found that the light curves could be calculated if the opacity–density relation were written in the form $k\rho = Ae^{-\alpha r} + Be^{-\beta r} + Ce^{-\gamma r}$, where r is the radial distance and A, B, C, α, β, and γ are constants. Close to the surface of the K star the opacity in the blue was greater than that in the ultraviolet. This led to the conclusion that the cumulative effect of line absorption was a possible source of opacity for the light of the B star. (auth)

46185 MEASUREMENT OF POLARIZED 10-MICRON RADIATION FROM COOL STARS WITH CIRCUMSTELLAR SHELLS. Capps, R. W.; Dyck, H. M. (Kitt Peak National Observatory, Tucson, Ariz.). Astrophys. J.; 175: No. 3, 693-7(1 Aug 1972).

Observations are reported of the linear polarization of 8 to 14-μ radiation from 10 cool stars. It was found that the level of measurable polarization is small, about 1%, but that a possibly significant detection was achieved for several stars. The implications of the data are discussed briefly. (auth)

46186 EARLY DATA FROM THE ULTRAVIOLET SKY-SCAN TELESCOPE IN THE TD1 SATELLITE. Wilson, R. (Astrophysics Research Unit, Culham, Eng.); Gardier, S.; Jamar, C.; (and others). Nature (London) Phys. Sci.; 238: No. 81, 34-6(17 Jul 1972).

An initial examination of data from the TD1 satellite telescope shows it to be functioning satisfactorily. The spectra observed are in good agreement with information obtained from rocket-borne telescopes. (auth)

46187 [illegible]TICAL OBSERVATIONS OF THE SUPERNOVA IN NGC 525[illegible] [illegible]ener, P. S. (Cerro Tololo Inter-American Observatory, La Serena, Chile); Hesser, J. E.; Kunkel, W. E.; (and others). Nature (London) Phys. Sci.; 238: No. 80, 21-2(10 Jul 1972).

The Type I supernova in NGC 5253, discovered recently, is stated to be of particular interest because of its brightness and because it is the second supernova to occur in this peculiar galaxy during the past 100 years. Some rather extensive studies made from Cerro Tololo are described, including UBV photometry and spectroscopic observations. The colors were found to be those of an F-Type star, suggesting that the emitting region is very large and fairly cool. No rapid variations in total light were observed. The spectroscopic observations showed the broad emission features characteristic of Type-I supernovae, as well as narrow interstellar features in the H and K lines. Additional bands in the uv and near-infrared, apparently not previously detected, were observed. Observations of the fluxes of the supernova in the wavelengths between the emission lines showed peaks near 5000 Å and, although the spectrum does not have a blackbody shape, the fluxes imply that the temperature of the emitting region is of the order 6 to 8×10^3K. If the region is optically thick it has a radius of $\sim 10^4$R . The upper limit for the expansion velocity appears to be 10,000 km/sec. (UK)

46188 EVIDENCE FOR THE HYDRODYNAMIC CHARACTER OF MICROTURBULENCE. Van Paradijs, J. A. (Univ., Amsterdam). Nature (London) Phys. Sci.; 238: No. 81, 37-8(17 Jul 1972).

The validity of determinations of the chemical composition of stellar atmospheres from observations of absorption lines in stellar spectra has been questioned (Worrall and Wilson, Nature, 236: 15(1972)), the main argument being directed against the concept of "microturbulence." This concept, which has been used for many years, is discussed, and observations are presented that support the concept and indicate that "microturbulence" is a real hydrodynamic effect. (UK)

46189 RELATIVISTIC ROCHE PROBLEM. Fishbone, Leslie G. (Univ. of Maryland, College Park). Astrophys. J.; 175: No. 3, L155-9(1 Aug 1972).

Bodies in orbit around Kerr black holes will experience tidal gravitational forces. The Roche limit for fluid bodies in stable circular orbits is qualitatively like that in Newtonian situations; for highly energetic circular orbits, the fluid density required for the existence of a body in equilibrium is magnified by the square of its energy-at-infinity per unit mass. (auth)

46190 CIRCUMSTELLAR MOLECULES IN THE PLEIADES. Hobbs, L. M. (Univ. of Chicago). Astrophys. J.; 175: No. 3, L145-7(1 Aug 1972).

Both old and new observations of the interstellar λ4232 line of CH^+ are considered for the brightest members of the Pleiades. They suggest that the molecules are circumstellar in some sense, perhaps resembling in this respect the micron-sized grains inferred to be present in this region. (auth)

46191 PRIMARY SPECTRUM OF THE ECLIPSING BINARY LR CENTAURI. Bessell, M. S. (Australian National Univ., Canberra). Astrophys. J.; 175: No. 3, L133-6(1 Aug 1972).

Coudé spectra and photoelectric scans were obtained during maximum light for LR Cen, an eclipsing binary of period 2.095595d variously suspected and discounted as being the pulsating x-ray source Cen X-3. These observations indicate the primary to be a reddened [E(B−V) ≈ 0.30], shallow-lined (v sin i = 300 km s^{-1}) B8.5 III star with several shell features, strong broad absorption at Ca H and K and Na D, strong narrow absorption at Na D, and Hα partly filled in. If one assumes synchronous rotation and orbital revolution, a radius of 12 $R_\odot$ is determined for the primary, in agreement with the x-ray results of Cen X-3. The star is filling its Roche lobe and possibly losing mass. (auth)

46192 BLACK HOLES IN THE BRANS–DICKE. THEORY OF GRAVITATION. Hawking, S. W. (Cambridge Univ., Eng.). Commun. Math. Phys.; 25: No. 2, 167-71(1972).

It is shown that a stationary space containing a black hole is a solution of the Brans–Dicke field equations if and only if it is a solution of the Einstein field equations. This implies that when the star collapses to form a black hole, it loses that fraction (about 7%) of its measured gravitational mass that arises from the scalar interaction. This mass loss is in addition to that caused by emission of scalar or tensor gravitational radiation. Another consequence is that there will not be any scalar gravitational radiation emitted when two black holes collide. (auth)

46193 BLACK HOLES IN GENERAL RELATIVITY. Hawking, S. W. (Cambridge Univ., Eng.). Commun. Math. Phys.; 25: No. 2, 152-66(1972).

It is assumed that the singularities which occur in gravitational collapse are not visible from outside but are hidden behind an event horizon. This means that one can still predict the future outside the event horizon. A black hole on a space-like surface is defined to be a connected component of the region of the surface bounded by the event horizon. As time increases, black holes may merge together but can never bifurcate. A black hole would be expected to settle down to a stationary state. It is shown that a stationary black hole must have a topologically spherical boundary and must be axisymmetric if it is rotating. These results together with those of Israel and Carter go most of the way towards establishing the conjecture that any stationary black hole is a Kerr solution. Using this conjecture and the result that the surface area of black holes can never decrease, one can place certain limits on the amount of energy that can be extracted from black holes. (auth)

46194 NEAR-INFRARED PHOTOMETRY OF MIRA VARIABLES. Lockwood, G. W. (Kitt Peak National Observatory, Tucson, Ariz.). Astrophys. J., Suppl. Ser.; 24: No. 209, 375-419(Jun 1972).

A five-color narrow-band photometric system is described which has been used for determining magnitudes at 1.04 μ, near-infrared colors, and molecular band-strength indices for M stars. The system gives accurate spectral types from M4 to M10 and useful, though less accurate, spectral types from M0 to M4. Mean 1.04 μ magnitudes, near-infrared colors, and spectral-type indices are given for photometric and spectroscopic standard stars, and 1795 individual sets of five-color measurements are given for 292 M- and S-type Mira variables. The Miras are shown to map out large loops in a diagram of molecular band strength as a function of color, and large differences of band strength can occur at a given color and phase in different stars or in the same stars during different cycles. The Miras with periods less than 300d are warmer by several hundred degrees at a given spectral type than either the normal giants used for calibration or the Miras with periods longer than 300d. The mean phase of earliest spectral type is ~0.03, while maximum light at 1.04 μ occurs at ~0.11. Minimum light at 1.04 μ and latest spectral type are reached almost simultaneously with minimum visual light. (auth)

46195 LINEAR PULSATIONS AND STABILITY OF DIFFERENTIALLY ROTATING STELLAR MODELS. I. NEWTONIAN ANALYSIS. Schutz, Bernard F. Jr. (California Inst. of Tech., Pasadena). Astrophys. J., Suppl. Ser.; 24: No. 208, 319-4[illegible] (May 1972).

A systematic method is presented for deriving the Lagrangian governing the evolution of small perturbations of arbitrary flows

of a self-gravitating perfect fluid. The method is applied to a differentially rotating stellar model; the result is a Lagrangian equivalent to that of Lynden-Bell and Ostriker. A sufficient condition for stability of rotating stars, derived from this Lagrangian, is simplified greatly by using as trial functions not the three components of the Lagrangian displacement vector, but three scalar functions. This change of variables saves one from integrating twice over the star to find the effect of the perturbed gravitational field. (auth)

46196 LINEAR PULSATIONS AND STABILITY OF DIFFERENTIALLY ROTATING STELLAR MODELS. II. GENERAL RELATIVISTIC ANALYSIS. Schutz, Bernard F. Jr. (California Inst. of Tech., Pasadena). Astrophys. J., Suppl. Ser.; 24: No. 208, 343-74(May 1972).

The author has previously given an Eulerian velocity-potential variational principle for relativistic perfect-fluid hydrodynamics. The second variation of the principle is here used as the Lagrangian density governing the evolution of small perturbations of fully relativistic, differentially rotating stellar models. Noether's theorem is used to construct a globally conserved angular-momentum density, whose integral over a spacelike hypersurface is the second-order correction to the star's total angular momentum. From the Hamiltonian is constructed a globally conserved energy density, whose integral is the second-order correction to the star's active gravitational mass. By Liapunov's second theorem, positive-definiteness of the energy density guarantees stability of the star. In the Newtonian limit and in the special case of relativistic radial pulsations, this is equivalent to stability criteria already known. Means are discussed whereby the general criterion might be made more suitable for practical applications. (auth)

46197 STARS WITH DARK COMPANIONS. Prosen, Marijan. Obz. Mat. Fiz.; 18: No. 1, 20-3(Mar 1971). (In Slovenian).

This contribution deals with a short survey of investigations of the stars supposed to have dark companions. Periodic perturbations of the proper motion of the near star may be explained by existence of one or more dark companions moving around the star. The perturbations of the proper motion of BD + 4°3561 are explained by the possibility that two dark companions, with masses like Jupiter and Saturn, could be moving around it. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

46198 FINE STRUCTURE IN H II REGIONS. Balick, Bruce. Ithaca, N. Y.; Cornell Univ. (1971). 184p. University Microfilms Order No. 72-15,390.

Thesis.

Interferometric studies at λ3.7 and 11.1 cm are reported for the H II regions DR 21, W51 components G49.5-0.4 and G49.3-0.3, W33, NGC 2264S, and IC 410. At these wavelengths the resolutions are 3″ and 10″, respectively; the former is the best resolution yet achieved for the mapping of H II regions. Some of the nebulae are shown to exhibit strong variations in their radio intensity called fine structure, with scale sizes of $10^{-1.5}$ pc. Other H II regions show either intermediate structure ($10^{-0.5}$ pc) or no structure at all. An accurate method is developed to estimate the emission measure and electron temperature based on the spectral behavior of the structure emission. Typical fine-structure emission measures of $10^{7.5}$ pc cm^{-6} and electron temperatures of 10^{4}°K were found. From this, electron densities of $10^{4.5}$ cm^{-3} and nebular masses of 10^{-1} $M_{\odot}$ can be deduced. Since pressure gradients associated with the high densities will tend to dissociate the structure, mechanisms which might confine or resupply the density are explored. Two models emerge as possible explanations. One is based on flows from high-density neutral material imbedded within the H II region. The second depends on neutral gas of a protostellar cocoon to confine a high-density H II region in its interior. The first of these models is shown to be slightly preferable on the basis of its compatibility with other properties of H II regions. In addition, a model for the well-studied core of the Orion nebula based entirely on flows is constructed; it is shown that this model is the first to provide an interpretive framework for all available radio and optical observations of Orion. (Diss. Abstr. Int., B)

46199 OBSERVATION OF PULSED GAMMA RAYS WITH ENERGIES GREATER THAN 250 keV FROM THE CRAB NEBULA PULSAR NP 0532. Orwig, Larry Eugene. Durham, N. H.; Univ. of New Hampshire (1972). 231p. University Microfilms Order No. 72-19,028.

Thesis.

Data from a balloon flight experiment using an 11½″ diameter × 4″ thick NaI scintillation spectrometer were analyzed to search for gamma-ray pulsations from NP 0532. The flight was conducted on June 7, 1970, and the payload was carried to a nominal atmospheric depth of 3.5 g/cm^2. The detector was pointing in the direction of the Crab Nebula for the entire time at float altitude. A superposed epoch analysis was performed on a 12,000 second portion of the data spanning a total time interval of 16,700 seconds at float altitude. A positive pulsed contribution was observed at the expected apparent frequency of NP 0532 having the double pulse structure typical of NP 0532. The results indicate a time-averaged pulsed photon flux of $(1.44 \pm 0.57) \times 10^{-3}$ photons cm^{-2} sec^{-1} in the energy interval from 250 keV to 2.3 MeV. This represents a time-averaged pulsed power of $I = (6.49 \pm 2.57) \times 10^{-4}$ keV cm^{-2} sec^{-1} keV^{-1}. The ratio of interpulse to main pulse was found to be 2.4 ± 1.9. A further subdivision of the energy interval was performed to obtain spectral information above 250 keV. Although the data is statistically very marginal, the analysis indicates a positive photon flux from 250 keV to 725 keV of $(1.20 \pm 0.52) \times 10^{-3}$ photons cm^{-2} sec^{-1} or a time-average pulsed power of $(1.14 \pm 0.50) \times 10^{-3}$ keV cm^{-2} sec^{-1} keV^{-1}. Above 725 keV no pulsed contribution was found. Therefore, upper limits at the 95% confidence level were obtained for two energy bins, one extending from 725 keV to 2.3 MeV, and the second an integral channel above 2.3 MeV. No evidence was found for an enhancement in the pulsed flux at the 0.5 MeV annihilation-line region. (Diss. Abstr. Int., B)

46200 OBSERVATIONS OF 3C 272.1 AT 2.7 AND 5.0 GHz. Riley, J. M. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 157: No. 4, 349-57(1972).

The radio source 3C 272.1, associated with the elliptical galaxy $M8_4$ in the Virgo cluster, was observed at 2.7 and 5.0 GHz with half-power beam widths of 12 × 52″ arc and 6.5 × 28″ arc, respectively. The maps obtained show that the source has a spiral structure. Linear polarization of up to 20% in places was found, consistent with a magnetic field predominantly perpendicular to the axis of the spiral. (auth)

46201 RELATIVISTIC BEAMING. McCrea, W. H. (Univ. of Sussex, Brighton, Eng.). Mon. Notic. Roy. Astron. Soc.; 157: No. 4, 359-65(1972).

Working in terms of photon-fluxes rather than other radiational parameters, a short self-contained treatment is given of the observable properties of a revolving light-source recently discussed by F. G. Smith (1970, 1971) in connection with a theory of the radiation of pulsars. (auth)

46202 ACCURATE POSITIONS OF RADIO SOURCES AT 408 MHz. Hunstead, R. W. (Univ. of Sydney). Mon. Notic. Roy. Astron. Soc.; 157: No. 4, 367-402(1972).

The Molonglo radio telescope was used to measure positions and flux densities for 314 small-diameter radio sources between declinations of +19° and −80°. The mean estimated errors in position were less than 1.5′ in right ascension and 2.0′ in declination; this accuracy was confirmed by a limited series of comparisons with precise interferometer positions. A large fraction of previously suggested southern identifications was not supported by the more accurate radio positions. Source extensions were found in 25% of the listed sources by application of a sensitive method for detecting the direction of elongation. (auth)

46203 OBSERVATIONS OF THE SUPERNOVA REMNANT IC 443 AT 1.42 GHz. Hill, I. E. Mon. Notic. Roy. Astron. Soc.; 157: No. 4, 419-31(1972).

The supernova remnant IC_{443} was mapped at 1.42 GHz with a resolution of 1.05 × 2.71′ arc, using the Half-Mile telescope at Cambridge. The map shows that the source has a thick shell extending over the eastern half of its circumference with no evidence of a shell on the western edge. There is remarkably detailed agreement of optical and radio features, with some optical filaments clearly located on the outer edge of radio ridges. Comparison of the map with other high-resolution maps at higher frequencies shows an increase in the spectral index near the brightest optical features. Estimates of some physical parameters of the source are derived in the final section of the paper. (auth)

46204 POLARIZATION OF RADIO SOURCES AT λ49 CM AND λ73 CM. Conway, R. G.; Gilbert, J. A.; Kronberg, P. P.; Strom, R. G. (Univ. of Manchester, Jodrell Bank, Eng.). Mon. Notic. Roy. Astron. Soc.; 157: No. 4, 443-59(1972).

Measurements are presented of the flux density at λ73 cm and the linear polarization at λ49 and λ73 cm of extragalactic sources, mostly quasars. These measurements establish the degree to which the linear polarization decreases at long wavelengths. Evidence is presented that the depolarization does not occur in the galactic halo. Little or no depolarization seems to occur in radio

variables. The polarization at λ49 cm of two sources (3C 454.3 and BL Lac) may have changed over a period of one year. (auth)

46205 VARIABILITY OF THE OH SOURCE W3. Wilson, A. J.; Davies, R. D.; Ellder, J. (Nuffield Radio Astronomy Labs., Jordell Bank, Eng.). Mon. Notic. Roy. Astron. Soc.; 157: No. 4, 21P-6P(1972).

Variability was detected in the 1665 MHz spectrum of the W_3OH source. Observations extending back to 1965 show an average decrease of $8.9 \pm 0.9\%$ per year in the -41.7 km s^{-1} feature. Irregular variability on the time scale of a few years is also found. The implications of these observations are discussed. (auth)

46206 MICROWAVE CELESTIAL WATER-VAPOR SOURCES. Johnston, K. J.; Knowles, S. H.; Schwartz, P. R. (Naval Research Lab., Washington, D. C.). Sky Telesc.; 44: No. 2, 88-90 (Aug 1972).

Microwave emission from water vapor sources has been detected in two types of sources; OH–H II regions and cool, late M-type stars. These two sources are briefly discussed. (W.D.M.)

46207 POLARIZATION APERTURE SYNTHESIS OF FIVE GALACTIC NONTHERMAL RADIO SOURCES. Hermann, Bruce Raymond. Urbana, Ill.; Univ. of Illinois (1972). 329p. University Microfilms Order No. 72-19,846.

Thesis.

Five possible supernova remnants were mapped using the techniques of aperture synthesis interferometry. The objects 3C 10 (Tycho's supernova), 3C 58, DR 4 (the Gamma-Cygni radio source), 4C 28.16 (located in the shell of S-147), and 3C 358 (Kepler's supernova) were mapped at 11.1 cm wavelength with the National Radio Astronomy Observatory's three-element interferometer. Intensity maps, polarization intensity maps, and electric vector position angle maps were obtained. A special polarization calibration scheme for this instrument was developed which employs both the tensor approach of Ko (I.E.E.E. Transactions of Antennas and Propagation, AP-15, p. 10, 1967) and the empirical correction procedure of Conway and Kronberg (M.N.R.A.S., 142, p. 11, 1969). (Diss. Abstr. Int., B)

46208 ABILITY OF THE LUMINOSITY-VOLUME TEST TO REVEAL THE STATISTICAL EVOLUTION OF THE LUMINOSITY OF QUASI-STELLAR SOURCES. Lynds, Roger (Kitt Peak National Observatory, Tucson, Ariz.); Petrosian, Vahe. Astrophys. J.; 175: No. 3, 591-9(1 Aug 1972).

The principles and capabilities of the luminosity–volume test and source-count analysis as procedures for studying the statistical evolution of the radio and optical luminosities of quasi-stellar sources are reviewed. In contrast to the conclusions expressed by Longair and Scheuer, a comparison of the two methods reveals that the luminosity–volume test is substantially more powerful and lucid and that a knowledge of the individual redshifts of objects is required for the most comprehensive determination of the evolutionary history of quasi-stellar sources. (auth)

46209 VRS FOR VRO. Swenson, G. W. (Univ. of Illinois, Urbana). Nature (London) Phys. Sci.; 238: No. 81, 37(17 Jul 1972).

Reference is made to use of the designation VRO for cosmic radio sources. Originally, this designation referred to the Vermilion River Observatory at the University of Illinois, but subsequently it has been used to indicate "variable radio object." Of the large number of sources in the Vermilion River Observatory catalog very few are known to be "variable radio objects" and in order to avoid confusion it is suggested that the designation VRS ("variable radio source") would be better for this class of object. (UK)

46210 TON 155 AND 156: A DOUBLE QUASAR. Stockton, A. N. (Univ. of Hawaii, Honolulu). Nature (London) Phys. Sci.; 238: No. 81, 37(17 Jul 1972).

It has been shown that Ton 156 is a quasar (Janes and Lynds, Astrophys. J. Lett., 155: L47(1969)), although a satisfactory redshift could not be determined. Spectroscopic observations by the present author, using the Mauna Kea 224-cm telescope, indicated that Ton 155, located at about 35" arc north of Ton 156, is also a quasar, and also allowed redshifts to be determined for both objects. Thus the possibility of a double quasar arises. The observations also give support to the possibility that not all quasar redshifts are cosmological. (UK)

46211 OBSERVATION OF A HARD X-RAY FLARE IN CYG X-1. Agrawal, P. C. (Tata Inst. of Fundamental Research, Bombay). Nature (London) Phys. Sci.; 238: No. 80, 22-3(10 Jul 1972).

Data obtained during a balloon flight from Hyderabad on the night of April 6, 1971 (Nature, 232: 38(1971)) were reanalyzed on a minute-to-minute basis to examine further possible structures in time variation of hard x rays. This analysis revealed the occurrence of a "flare" in Cyg X-1 similar in characteristics to those recorded in Sco X-1. Details of this flare are reported. This appears to be the first observation of a hard x-ray flare in Cyg X-1. (UK)

46212 ASSOCIATION OF X-RAY SOURCES WITH BRIGHT STARS. Gursky, Herbert (American Science and Engineering, Cambridge, Mass.). Astrophys. J.; 175: No. 3, L141-4(1 Aug 1972).

A comparison of selected Uhuru x-ray sources with the SAO star catalog reveals 10 stars within the positional error of the x-ray sources where only about two are expected on the basis of chance. Three of these are already under study as optical candidates for x-ray sources. The new results lend confidence to these candidates as being correct and yield candidate stars for seven other x-ray sources. The association of bright stars with x-ray sources is expected on the basis of the model which invokes mass transfer from a massive star to a compact companion. (auth)

46213 OPTICAL SEARCH FOR CENTAURUS X-3. Brucato, R. J.; Kristian, J.; Westphal, J. A. (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Astrophys. J.; 175: No. 3, L137-9(1 Aug 1972).

The optical eclipsing binary LR Cen has been eliminated as a candidate for Cen X-3 on the basis of a real discrepancy of orbital periods. It is believed that the position coincidence of Wray 795 with Cen X-3 is not statistically significant. (auth)

46214 DETECTION OF HIGH-ENERGY GAMMA RAYS FROM THE CRAB NEBULA. Fazio, G. G.; Helmken, H. F.; O'Mongain, E.; Weekes, T. C. (Smithsonian Astrophysical Observatory, Cambridge, Mass.). Astrophys. J.; 175: No. 3, L117-22(1 Aug 1972).

By means of the ground-based atmospheric Cherenkov technique, observations of the Crab Nebula, averaged over a 3-year period, indicate that a flux of γ rays ($4.4 \pm 1.4 \times 10^{-11}$ photons $cm^{-2}s^{-1}$) with energy $\geq 2.5 \times 10^{11}$ eV has been detected at the 3.1 σ level. This flux corresponds to an emission of 6×10^{33} ergs s^{-1}, significantly less than the continuous x-ray emission. The γ-ray flux may vary with time, with the most significant flux ($1.21 \pm 0.24 \times 10^{-10}$ photons $cm^{-2}s^{-1}$) occurring 60 to 120 days after a major spin-up of the pulsar NP 0532. This increase was observed on three different occasions, and if the flux in only these intervals is used, the effect is at the 5 σ level. The total γ-ray energy observed on each occasion was $\sim 10^{41}$ ergs, an energy approximately equal to the energy of the pulsar spinup. (auth)

46215 EXTRAGALACTIC ORIGIN OF THE TRANSIENT X-RAY SOURCES. Sofia, Sabatino (Univ. of South Florida, Tampa). Astrophys. J.; 175: No. 3, L113-15(1 Aug 1972).

It is shown that the current assumption that the transient x-ray source 2U 1543-47 is located within our Galaxy leads to serious energetic difficulties. However, all the presently available observations are consistent with the interpretation that the source was produced by a supernova event in a nearby galaxy. On the assumption that the nature of this source is similar to that of the other known transient sources, observational tests are proposed to verify their extragalactic origin. (auth)

46216 POLARIZED RADIO EMISSION FROM FIVE SUPERNOVA REMNANTS. Milne, D. K. (CSIRO, Epping, Australia). Aust. J. Phys.; 25: No. 3, 307-13(Jun 1972).

Maps are presented of the polarization and total power emission at 2700 MHz from five southern supernova remnants: MSH 09–32, 10–53, 14–63, 15–52, and 15–56. Observations of 14–63 and 15–56 at 1410 MHz are also presented. (auth)

Solar Phenomena

Refer also to abstract: 47143.

46217 SOLAR RADIO SPIKE BURSTS. Tarnstrom, Guy LaVern. College, Alaska; Univ. of Alaska (1971). 184p. University Microfilms Order No. 72-17,101.

Thesis.

Spectral observations of meter wavelength solar radio emission with ≤ 0.01 second time-resolution show three types of spike bursts: fast drift spike bursts, with $\dot{f} \geq 100$ MHz; medium drift spike bursts, with $\dot{f} < 100$ MHz; and simple spike bursts, of ~1-MHz bandwidth and no apparent frequency drift. All types of spike bursts tend to occur in regular sequences of similar busts. Rare, extensive sequences of quasi-periodic fast-drift spike bursts are observed. Fine structure of Type-III burst events reveal occa-

sional spike burst–Type-III burst associations which appear to fall into three classes. Type III bursts are observed with duration ~0.1 second approaching the range of spike-burst durations (≲0.1 second). Large-frequency-range spike bursts resemble such short-duration Type III bursts, suggesting a morphological continuity between spike bursts and Type-III bursts. A plasma hypothesis interpretation of spike bursts requires spike burst exciters of spatial extent less than ~10^3 to 10^4 km, density ~1 to 10 electrons/cm^3, and coronal temperature ~$10^{6\circ}$K. It is suggested that the spatial extent of a given exciter determines whether a spike burst or a Type-III burst is produced. Unusual meter-wavelength fine structure observed includes spike burst and Type-I burst chains with a sharp high-frequency cutoff, complex patterns of parallel drifting bands, and ionospheric scintillation of noise-storm continuum. Several examples are given. (Diss. Abstr. Int., B)

46218 CONTINUUM NEAR THE H AND K LINES OF Ca^+ IN THE SOLAR SPECTRUM. Matsushima, Satoshi; Kawabata, Kiyosh (Pennsylvania State Univ., University Park). Astrophys. Lett.; 11: No. 3, 103-6(Jul 1972).

A method is proposed for the determination of the true continuum for the spectral region where no continuum is visible. The method is based on the use of the characteristic weakening of absorption lines due to blending with a strong line and thereby eliminates various uncertainties involved in theoretical methods attempted earlier. The continuum determined by this method for the H and K lines of Ca^+ in the solar spectrum is about 10 to 15% higher than the newest empirical determination, and is in good agreement with higher values suggested by earlier workers. (auth)

46219 EVIDENCE FOR SOLAR PARTICLE PRODUCTION ABOVE ~ 75 GeV. Schindler, S. M.; Kearney, P. D. (Colorado State Univ., Ft. Collins). Nature (London); 237: No. 5357, 503-5 (30 Jun 1972).

The first direct experimental evidence is presented for solar-particle production in the energy region above the maximum vertical geomagnetic cutoff; this was the outcome of an experiment specifically designed for the detection of solar-generated particles in the energy region above ~75 GeV. The detector was a narrow-angle muon telescope consisting of three in-line plastic scintillators and two narrow-gap spark chambers, mounted on a solar tracking equatorial mount. For specific resolution of a very high energy solar particle component the detecting system was located underground at a depth of 200 m at Idaho Springs, Colorado. On Oct. 3rd 1971 a positive correlation was obtained between a significant intensity increase and a specific solar flare event. Preliminary satellite data on the associated proton event are given. Only single station detection was observed, but this is not unique in the history of solar-related particle events. It is considered that the results constitute good evidence for particle acceleration occurring during the initial phase of a solar flare. No specific acceleration mechanism is postulated to account for the results. (UK)

46220 SIZE OF THE DUST PARTICLES OF A COMET ATMOSPHERE AND THE HELIOCENTRIC DISTANCE. Dobrovol'skii, O. V.; Ibadinov, Kh. (Inst. of Astrophysics, Dushanbe, USSR). Dokl. Akad. Nauk Tadzh. SSR; 15: No. 2, 15-18(1972). (In Russian).

Possible factors that might affect the size of the dust particles in a comet were considered, e.g.: the free flight path of particles during the sublimation of ice, the collapse of the surface of the dust matrix, and the formation of particles in the near-nuclear region of the head by means of condensation, any of which may be related to the heliocentric distance of the comet. During the free escape of dust particles from the surface of the nucleus under the influence of gas pressure, the average diameter of comet particles and the magnitude of their effective acceleration at 4 AU from the Sun is basically a function of the structure of the nucleus and not of the heliocentric distance. Formation of dust by condensation in the near-nuclear region of the head leads to growth of particle dimensions with decreasing heliocentric distance. (K.S.W.)

46221 EXCITER OF TYPE III BURSTS AND CORONAL TEMPERATURE. Aubier, M.; Boischot, A. (Observatoire, Meudon, France). Astron. Astrophys.; 19: No. 3, 343-53 (Jul 1972).

The time profiles of Type-III solar radio bursts are often used to determine some characteristics of the burst exciter, and the temperature of the corona at different heights. It is shown that, under certain hypothesis, the time profiles give independently the duration of the exciter and the decay time constant of the burst. New observations of Type-III bursts in the decameter range are presented. They were obtained with the 1000-ft dish of Arecibo (Puerto-Rico). The analysis of the time profiles leads to average total durations of the exciter function of 3.9, 6.2, and 7.5 s and average decay time constants of 1.2, 1.7, and 2.0 s at 60, 36.9, and 29.3 MHz, respectively. The values of these two parameters scatter around these averages from burst to burst and from day to day within a factor of approximately 3. A relation is found between the duration and the decay time constant derived with the above method. This relation brings some doubt on the significance of the coronal temperature derived from the decay time constant with the hypothesis of a collisional damping of the plasma waves. Other explanations are proposed. (auth)

46222 ACTIVE LONGITUDES OF SUNSPOTS AND SOLAR FLARES IN THE 20th CYCLE. Maris, Georgeta (Observatorul Astronomic, Bucharest). Stud. Cercet. Astron.; 17: No. 1, 71-7(1972). (In Rumanian).

The active longitudes of different indices for sunspots and solar flares were investigated by the isoline method, for the period July 1, 1964–December 31, 1969. It is shown that the active longitudes of sunspots and solar flares practically coincide. The rate of concentration in the active longitudes for different solar events is higher for more important events. The problems connected with north–south asymmetry of solar activity and of the concentration rate in the active longitudes are considered, also. (auth)

46223 RADIO AND X-RAY EMISSIONS ASSOCIATED WITH THE CHROMOSPHERIC FLARES OF NOVEMBER 15 AND 16, 1970. Maris, Georgeta (Observatorul Astronomic, Bucharest). Stud. Cercet. Astron.; 17: No. 1, 79-84(1972). (In Rumanian).

The radio bursts and x-ray emission associated with the chromospheric flares of November 15 and 16, 1970 are presented. The chromospheric flare of November 15 had two brightness maxima, one of 1B importance at 7h06mUT and one of 1N importance at 7h57mUT. There were two outstanding events in the x-ray range and very complicated radio bursts in the microwave range associated with this flare. The 2N importance flare of November 16 attained brightness maximum at 9h56mUT. There were not such complicated radio bursts as on November 15, but the x-ray flare was similar to the second x-ray flare on November 15. An explanation of these radio and x-ray emissions is proposed, in agreement with the comprehensive model of Takakura and Kai (1966). It is suggested that the differences between the associated phenomena of the two chromospheric flares were due to the different acceleration mechanism of the electrons. (auth)

46224 PHOTOSPHERIC FACULAE AND THE SOLAR OBLATENESS. Chapman, Gary A. (Aerospace Corp., El Segundo, Calif.); Ingersoll, Andrew P. Astrophys. J.; 175: No. 3, 819-29 (1 Aug 1972).

Photospheric faculae near the equatorial solar limb may provide the excess brightness which Ingersoll and Spiegel showed would explain Dicke and Goldenberg's oblateness measurement. Three lines of evidence support this statement: (1) the excess emission of faculae may arise in optically thin regions, as required by the Ingersoll–Spiegel hypothesis; (2) faculae are sufficiently widespread on the solar surface to account quantitatively for the observed signal; and (3) temporal fluctuations in the expected signal due to faculae in 1966 are correlated with fluctuations in the observed signal at the 1% level. (The probability of the correlation coefficient for uncorrelated data exceeding the observed value is less than 1%.) Although this evidence clearly demonstrates that faculae make a sizable contribution to the observed oblateness signal, it does not preclude an equally sizable contribution due to true gravitational oblateness. Evidence that faculae may not be the only source of oblateness signal comes from the apparent fact that the ratio of fluctuation amplitude to mean signal amplitude is greater for the facular signal than for the observed oblateness signal. However, this difference may be due to errors in reading the photographs from which the facular signal was derived, or to differences in processing the two sets of data. A better test of the hypothesis cannot be made until the daily oblateness signals and their standard deviations are available. In any case, it appears that further data analysis will be necessary before a reliable value of the solar oblateness can be inferred. (auth)

46225 FACULAE AND THE SOLAR OBLATENESS. Dicke, R. H. (Princeton Univ., N. J.). Astrophys. J.; 175: No. 3, 831-5(1 Aug 1972).

Chapman and Ingersoll (see preceding paper) have suggested that the excess solar oblateness found by Dicke and Goldenberg is wholly or largely due to the presence of faculae near the solar limb. This contrasts with the author's earlier statement based on a statistical study that contributions from faculae are unimportant. A new statistical study based on Chapman and Ingersoll's own facular function supports the author's 1970 statement. (auth)

46226 TIME-DEPENDENT IONIZATION EQUILIBRIUM AND LINE RADIATION UNDER FLARELIKE CONDITIONS. Kafatos, Minas C. (Massachusetts Inst. of Tech., Cambridge); Tucker, Wallace H. Astrophys. J.; 175: No. 3, 837-41(1 Aug 1972).

The results of calculations of time-dependent ionization equilibrium and line emission are presented and compared with the values obtained under the assumption that steady-state conditions prevail. In the models considered, it is assumed that the electron density is constant ($=10^9$ cm^{-3}) and that the temperature increases by a factor of 10 from 3×10^6°K on time scales ranging from 100 to 300 s and decays back to 3×10^6°K on a time scale ranging from 600 to 1400 s. Ions of oxygen and silicon are considered, and it is found that the spectrum is softer during the rise and harder during the fall than predicted by the steady-state approximation. (auth)

46227 DENSITY OF THE SOLAR CORONA FROM OCCULTATIONS OF NP 0532. Counselman III, C. C. (Massachusetts Inst. of Tech., Cambridge); Rankin, J. M. Astrophys. J.; 175: No. 3, 843-56(1 Aug 1972).

The mean electron density of the solar corona was determined from measurements of radio-frequency dispersion for pulsar NP 0532. In 1969 and 1970 mid-June, the density at 10 $r_\odot$ was 7000 ± 600 cm^{-3}, only one-half the value which others have inferred from eclipse and scintillation measurements at sunspot maximum. Between 5 and 20 $r_\odot$, the density varied with radius as the power -2.9 ± 0.2. Simultaneous measurements of coronal multipath scattering show that the mean density does not always increase when scattering is enhanced. In June 1971, the coronal density inferred from pulsar measurements under the south pole of the Sun was much less than in 1969 and 1970, although equatorial values did not appear to be significantly different. Coronal multipath scattering delays were generally less than one-tenth of their 1969–1970 level. (auth)

46228 STRUCTURE AND HEATING OF THE CHROMOSPHERE–CORONA TRANSITION REGION. Moore, Ronald Lee. Stanford, Calif.; Stanford Univ. (1972). 141p. University Microfilms Order No. 72-20,718.

Thesis.

A broad endeavor of solar physics is to determine from the observed radiation the structure of the solar atmosphere and the nature of the energy balance this structure implies. A basic feature of the solar atmosphere, which is still not well understood, is the chromosphere–corona transition region in which, in a height of a few thousand kilometers, the temperature increases from about 10^4°K at the top of the chromosphere to about 10^6°K at the bottom of the corona. The problem investigated in this dissertation is that of the structure and heating (or energy balance) of the transition region and the role of the transition region in the structure and heating of the atmosphere as a whole. (TSS) (Diss. Abstr. Int., B)

46229 ACCRETIONARY PROCESSES IN THE EARLY SOLAR SYSTEM: AN EXPERIMENTAL APPROACH. Kerridge, John F.; Vedder, James F. (Ames Research Center, Moffett Field, Calif.). Science; 177: No. 4044, 161-3(14 Jul 1972).

Micrometer-size silicate flakes do not accrete during impacts in the velocity range 1.5 to 9.5 kilometers per second. Conventional accretionary theories for silicate bodies are applicable only to particles whose orbits are similar. Metal–silicate fractionation in the solar system may have been affected by differences in the accretionary behavior of the metal and silicate particles. (auth)

46230 CONDITIONS FOR ACCELERATION OF PARTICLES IN SOLAR ATMOSPHERE. Velinov, P. I. (Geophysical Inst., Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 1, 35-8(1972).

Certain problems related to conditions necessary for acceleration of charged particles in the solar atmosphere are examined, particularly the effect of ionization losses, including both single and multiple ionization. This effect is essential in the range of relativistic energies, i.e., at the initial stage of acceleration when the chemical composition and spectrum of the solar cosmic rays are formed. (auth)

46231 THEORETICAL STUDIES OF THE FLUX AND ENERGY SPECTRUM OF GAMMA RADIATION FROM THE SUN. Cheng, Chung-chieh (Goddard Space Flight Center, Greenbelt, Md.). Space Sci. Rev.; 13: No. 1, 3-123(May 1972).

The various γ-ray-production mechanisms in solar flares were studied and the flux, the spectrum, and the decay curves of γ radiation were calculated. From the continuity equation, taking into account the energy losses for solar-flare-accelerated particles, the time-dependent particle distribution and the time behavior of the resulting γ rays were obtained. The important processes for producing γ rays in solar flares are found to be nonthermal electron bremsstrahlung, decay of neutral π mesons, positron annihilation, neutron capture, and decay of excited nuclei. The results are applied to several known solar flares. For a large flare such as the class 3^+ on February 23, 1956, continuous γ rays with energies up to 100 MeV from electron bremsstrahlung and neutral π meson decays are observable at the orbit of the Earth by existing γ-ray detectors. Line γ rays from positron annihilation (0.51 MeV), neutron capture (2.23 MeV), and deexcitation of excited nuclei ^{16}O (6.14 and 7.12 MeV) and ^{12}C (4.43 MeV) are particularly strong and well above the continuous γ-ray background due to electron bremsstrahlung. These lines can be detected at the Earth. (118 references) (auth)

46232 COMPOSITION AND ENERGY SPECTRA OF HEAVY NUCLEI WITH $0.5 < E < 40$ MeV PER NUCLEON IN THE JANUARY 24, AND SEPTEMBER 1, 1971 SOLAR FLARES. Crawford, H. J.; Price, P. B.; Sullivan, James D. (Univ. of California, Berkeley). Astrophys. J.; 175: No. 3, L149-53(1 Aug 1972).

Energy spectra of O, Si, and Fe between 0.5 and 40 MeV per nucleon were measured with stacks of plastic detectors exposed in a rocket during the January 24, 1971 flare. The Fe/Si ratio decreased from 1.8 ± 0.3 to 0.42 ± 0.14 with energy. In both the January 24 flare and the September 1 flare, the abundances of elements $10 \leq Z \leq 28$ at ~15 MeV per nucleon were similar to high-energy cosmic-ray source abundances; S, Ne, and Ar were significantly lower than current solar values. (auth)

46233 SPACE OBSERVATIONS OF THE SOLAR CORONA. Brueckner, Guenter E. (Naval Research Lab., Washington, D. C.). Astronaut. Aeronaut.; 10: No. 7, 24-30(Jul 1972).

Coronal observations made in the 20th century are briefly reviewed. Observing techniques in the uv region developed since the early 1960's are discussed in some detail and coronal structure is considered. (W.D.M.)

Galaxies

Refer also to abstracts: 46168 and 46761.

46234 SOME CURRENT STUDIES OF GALAXIES. Hoodge, Paul W. (Univ. of Washington, Seattle). Sky Telesc.; 44: No. 1, 23-7(Jul 1972).

Arguments on relationships between galaxies with different redshifts presented at the Seattle meeting of the AAS, April 1972, are summarized. Papers on peculiar galaxies, infrared studies, and normal galaxies are briefly reviewed. (W.D.M.)

46235 PREDOMINANT MOTION IN SPHERICAL SYSTEMS OF GALAXIES. Karachentsev, I. (Special Astrophysical Observatory, Moscow); Zonn, W.; Shcherbanovskii, A. Astrophys. Lett.; 11: No. 3, 151-4(Jul 1972).

Statistical study of kinematics of some clusters and groups of galaxies supports the hypothesis of their instability. The study is based on the examination of regression curves of radial velocities of members of a cluster on the projections (on the celestial sphere) of their distances from the center of a cluster. (auth)

46236 TWO NEW LARGE-DIAMETER GALACTIC REGIONS OF FAINT Hα EMISSION. Courtes, G.; Sivan, J. P. (CNRS, Marseille. Observatoire, Marseille). Astrophys. Lett.; 11: No. 3, 159-62(Jul 1972).

In order to detect the limit of the general emission of the Hα line in the Milky Way, a photographic survey was undertaken with a 55° field camera using a very narrow interference filter centered on Hα. Two of the plates revealed two new large-diameter regions of faint emission at high galactic latitudes. Coordinates, sizes, exciting stars, distances, and brightnesses are given. In one of these pictures, the whole Cygnus Complex is recorded. Morphological remarks are given. (auth)

46237 RADIO MAP OF THE SPIRAL GALAXY MAFFEI 2 AT 1415 MHz. Allen, Ronald J. (Sterrenkundig Laboratorium Kapteyn, Groningen, Netherlands); Raimond, Ernst. Astron. Astrophys.; 19: No. 3, 317-25(Jul 1972).

A field of one degree square centered near the infrared object Maffei 2 was observed with the Westerbork Synthesis Telescope in the radio continuum at 1415 MHz. The angular resolution of $26'' \times 31''$ was sufficient to reveal a nuclear source $19'' \pm 4''$ in diameter with a flux of 0.21 ± 0.01 flux units located near the optical center of Maffei 2. The nucleus is surrounded by a disk of emission 7.8×3.5 in angular size with a mean surface brightness of about 5°K at 1415 MHz. The radio morphology is consistent with the inference from previous infrared and radio H I

observations that Maffei 2 is a spiral galaxy. A region of increased radio intensity in the disk of the galaxy apparently coincides with a concentration of H II regions in a spiral arm. The radio continuum data would seem to favor a Hubble type of Sbc or later, and a distance of about 5 Mpc for Maffei 2. A list of incidental radio sources in the field is given, as well as the positions of eleven faint stars in the immediate neighborhood of the galaxy. (auth)

46238 EXTENDED VAN WIJK SEQUENCE IN THE LARGE MAGELLANIC CLOUD. Ardeberg, A. (European Southern Observatory, Santiago de Chile). Astron. Astrophys.; 19: No. 3, 384-7(Jul 1972).

Ten stars in the van Wijk sequence in the Large Magellanic Cloud were observed extensively in the UBV system using 5 E regions for standards. In V and (B−V) the results obtained were in very good agreement with previous results. However, for the (U−B) color indices the differences were considerable. With the present data the ten stars form a very suitable local photometric standard sequence for the Large Magellanic Cloud. (auth)

46239 STUDY OF THE CONTINUUM OF THE NUCLEI OF GALAXIES. II. Andrillat, Y.; Souffrin, S.; Alloin, D. (Observatoire, Meudon, France. Univ. Languedoc, Montpellier, France). Astron. Astrophys.; 19: No. 3, 405-16(Jul 1972).

A method previously described (Alloin et al., 1971a), based on the study of equivalent widths of absorption lines, was applied to determine the stellar population of the galactic nuclei and to compute a "synthetic" continuum that is compared with observation. Nuclei of four galaxies were studied: NGC 1052, NGC 2655, NGC 2903, NGC 4569. It was verified that the thermal continuous emission of the gas is negligible except for NGC 2903. For NGC 1052, NGC 2655, NGC 4569, it was possible to construct models of the stellar population which were consistent with the intensities of the absorption lines. These models incorporated a large proportion of K and M dwarfs (in order to account for the intensities of the Mg I and Na I lines). No intrinsic reddening appeared in the visible range (4000 to 6000 Å). For NGC 2903, the observed intensities of absorption lines could not be accounted for in terms of stellar radiation alone but must include an important contribution of nonstellar radiation in the blue (30% at 4000 Å), thus explaining the abnormal blue color of the galaxy. The presence of super-metal rich stars in the galactic nuclei would not affect the relative stellar contributions, nor the conclusion concerning the presence of nonthermal radiation in NGC 2903. However, since the synthetic continua would be "bluer," an intrinsic reddening would be needed to account for the observations. (auth)

46240 INTERSTELLAR ORGANIC CHEMISTRY. Sagan, Carl (Cornell Univ., Ithaca, N. Y.). Nature (London); 238: No. 5359, 77-80(14 Jul 1972).

Complex organic molecules that are stable against radiation may pervade interstellar space, with their degradation products a source of those molecules observed. The connection between biological and interstellar organic chemistry is, however, analogical rather than substantive, and the prospect for interstellar biology is dim. (auth)

46241 CORRELATION OF REDSHIFT WITH MAGNITUDE AND MORPHOLOGY IN THE COMA CLUSTER. Tifft, W. G. (Univ. of Arizona, Tucson). Astrophys. J.; 175: No. 3, 613-25(1 Aug 1972).

Redshifts and magnitudes for nearly 100 galaxies in the core of the Coma cluster are now available. The sample is nearly complete to seventeenth magnitude for the nuclear regions (central 4.8 in. spot). Nearly all the higher-redshift galaxies in the Coma cluster are nonellipticals. The separation of the ellipticals from the nonellipticals is significant in both the redshift and magnitude coordinates and is shown to be a maximum in a linear combination of redshift and magnitude along a direction sloping close to 0.6 mag fainter per 1000 km s^{-1} increase in redshift. The morphological separation is in the same sense as the pattern in the Virgo cluster. When the redshift−magnitude diagram is examined in the direction of the maximum morphological separation, it is shown to have a strongly banded structure which is not present in any other direction. The observed redshift−magnitude pattern is compared with an outlying distinct group of galaxies in the Coma cluster which shows a nearly identical pattern slightly shifted in redshift. The pattern is also used to predict the (m, log z)-diagram for field galaxies. Observed field galaxies are shown to fit the predicted pattern and to deviate from the normal velocity-dispersion model. After allowance for magnitude and redshift uncertainties it is shown that residual true Doppler velocity dispersion in the Coma cluster cannot exceed about 220 km s^{-1}, and the cluster is not dynamically unstable. In the presence of an intrinsic unexplained redshift which produced the observed pattern, the mean redshift of a group of galaxies need not be the same as the Hubble velocity of the cluster. Systematic trends in the deviation of the Hubble velocity from the mean redshift are possible due to selection with distance and may explain the local apparent dependence of the Hubble constant on distance. (auth)

46242 STRUCTURE OF THE COMA CLUSTER OF GALAXIES. Rood, Herbert J. (Wesleyan Univ., Middletown, Conn.); Page, Thornton L.; Kintner, Eric C.; King, Ivan R. Astrophys. J.; 175: No. 3, 627-47(1 Aug 1972).

Radial velocities in the Coma cluster, many of them new, are analyzed in conjunction with previous data on the density distribution. The cluster extends more than 200′ in radius, with bright and faint galaxies distributed nearly the same. Some spirals are members. Several different determinations of M/L give values around 250. The cluster is stabilized by a "missing mass" some 7 times the mass of the galaxies, which must be distributed in the same way as the galaxies. (auth)

46243 RADIAL CYANOGEN-BAND GRADIENTS NEAR THE NUCLEI OF GALAXIES. Spinrad, Hyron (Univ. of California, Berkeley); Smith, Harding E.; Taylor, Donald J. Astrophys. J.; 175: No. 3, 649-57(1 Aug 1972).

Very high spatial-resolution area scans of the nuclear regions of eight nearby galaxies, of types E0−E5, S0, Sa, and Sb were obtained in 1970−1971 with 33-Å spectral purity at the blue λ4200 CN band. Partly confirming and extending previous work of McClure and Spinrad et al., all galaxies scanned to show either zero or negative radial CN-band-strength gradients. The strength of the CN gradient along the major axis was found to be inversely correlated with the degree of flattening of the system. Also, scans of NGC 3115 shows a substantial CN decrease along the minor axis while the CN strength is constant along the major axis. The interpretations of the CN gradients are briefly discussed in terms of differences in chemical composition relating to the dynamical histories of simple spherical and flattened systems. (auth)

46244 ABUNDANCES OF INTERSTELLAR MOLECULES. Watson, W. D.; Salpeter, E. E. (Cornell Univ., Ithaca, N. Y.). Astrophys. J.; 175: No. 3, 659-71(1 Aug 1972).

Equilibrium abundances were calculated for various molecules in interstellar H I gas clouds using rates from a previous paper for molecule formation on grain surfaces, and rates from other authors for gas-phase reactions and for photodissociation. Results depend on a parameter $\xi \sim (n/100\ \mathrm{H\ cm^{-3}})\ \exp(2.5\tau_v)$, where n is gas density and τ_v is the visual optical depth from points inside the cloud to its surface. Molecules probably are not depleted by condensation if $\xi \lesssim 10^4$ (but the situation is uncertain if grains with ice mantles are present). For slightly shielded clouds ($\xi \lesssim 10$) where hydrogen is mainly atomic and carbon is mainly C^+, the combined abundances of various molecules containing C, N, or O were estimated (relative to atomic C, N, and O) to be $\sim 10^{-4}\xi$. When ξ exceeds some critical value ~300, the neutral C in the gas eliminates photons beyond 11.3 eV; because of their high binding energy, CO molecules are then not dissociated and are expected to be almost as abundant as C atoms. Abundances (with even greater uncertainties) are also estimated for the more complex molecules. (45 references) (auth)

46245 FORMATION OF CLOUDS IN A COOLING INTERSTELLAR MEDIUM. Schwarz, Joseph (Harvard Coll. Observatory, Cambridge, Mass.); McCray, Richard; Stein, Robert F. Astrophys. J.; 175: No. 3, 673-86(1 Aug 1972).

An interstellar medium cooling from 8200°K after sudden heating (e.g., by soft x rays or by low-energy cosmic rays) favors the development of thermal condensations. One-dimensional hydrodynamic calculations show that the condensation process will yield interstellar clouds with densities of ~100 times the intercloud density, given a small (~10%) initial density perturbation, provided the scale length λ of the initial perturbation satisfies $\lambda_c \lesssim c\tau_c$, where c is the sound speed in the gas and τ_c is the radiative cooling time. The condensations reach maximum density in a few cooling timescales. For an initially uniform medium of density $n_H = 0.3$ hydrogen atoms per cm^3 that is 5% ionized, a density perturbation of wavelength 3 pc will grow by a factor of 100 in about 10^6 years, reaching a final ionized fraction $x \simeq 10^{-3}$ and temperature $T \lesssim 20$°K. The intercloud medium at this time will have cooled to about 2000°K. In the one-dimensional case, the final extent of the cloud will be about 0.01 pc. Cloud dimensions more typical of those observed in the interstellar medium are a likely result of a three-dimensional treatment of this problem. An increase in the critical condensation wavelength λ_c, as well as higher temperatures for the time-dependent intercloud medium, will result if cooling agents such as C, Si, Fe, and O are more highly ionized than assumed in these calculations. Soft x rays are a plausible source of such anomalously high ionization. (auth)

46246 STUDY OF NEUTRAL HYDROGEN GAS MOTION WITHIN SPIRAL ARMS AND IN THE LOCAL REGION. Harten, Ronald Harold. College Park, Md.; Univ. of Maryland (1972). 132p. University Microfilms Order No. 72-20,492.

Thesis.

Data from several recent high resolution 21-cm line studies was analyzed in a two-part study of the motions of the neutral-hydrogen gas within spiral-arm features. This study considers particularly the structure of the gas motions perpendicular to the galactic plane. (TSS) (Diss. Abstr. Int., B)

46247 HIGH-FREQUENCY RESOLUTION H I LINE OBSERVATIONS OF INTERSTELLAR DUST CLOUDS. Knapp, Gillian Revill. College Park, Md.; Univ. of Maryland (1972). 263p. University Microfilms Order No. 72-20,253.

Thesis.

The density and temperature of atomic hydrogen in dense interstellar dust clouds were investigated by searching for narrow self-absorption dips in the 21-cm emission profiles in the directions of such clouds. The observations were made with the 140-foot telescope of the National Radio Astronomy Observatory. It was found that about half of the dust clouds observed showed self-absorption dips and that the greater the observed optical density of the clouds the greater the chance of their showing up in self-absorption. (TSS) (Diss. Abstr. Int., B)

46248 LUMINOSITY-SPECTRAL INDEX RELATIONSHIP FOR RADIO GALAXIES. Macleod, J. M.; Doherty, L. H. (National Research Council of Canada, Ottawa). Nature (London); 238: No. 5359, 88-9(14 Jul 1972).

It is stated that the relationship between spectral index and luminosity for the 3CR extragalactic sources suggests that sources with high radio luminosity have, on the average, steeper spectra than do low-luminosity sources, but the scatter in the relationship is quite large. Furthermore, correlation exists only for radio galaxies and not for quasars. It is shown here that, even for radio galaxies, the relationship holds only for a particular subgroup in the 3CR catalog. For those galaxies with power-law spectra there is a clear relationship between luminosity and spectral index, but for those galaxies that do not have simple power-law spectra luminosity is independent of spectral index. (UK)

46249 RELATIONSHIP BETWEEN X-RAY LUMINOSITY AND VELOCITY DISPERSION IN CLUSTERS OF GALAXIES. Solinger, Alan B.; Tucker, Wallace H. (American Science and Engineering, Cambridge, Mass.). Astrophys. J.; 175: No. 3, L107-11(1 Aug 1972).

The connection between the x-ray luminosity L_X and the dynamics of clusters of galaxies is considered. L_X is found to be strongly correlated with the velocity dispersion ΔV. The observed relationship can be explained most simply within the framework of a thermal-bremsstrahlung model with the x-ray luminous mass being a fraction of the cluster binding mass. This implies that the clusters are or were gravitationally bound. The x-ray intensities or velocity dispersions are predicted for several clusters. (auth)

46250 BRIGHT NEBULAE NEAR CONCENTRATIONS OF HIGH-VELOCITY GAS. Minkowski, R. (Univ. of California, Berkeley); Silk, Joseph; Siluk, Richard S. Astrophys. J.; 175: No. 3, L123-5(1 Aug 1972).

Some coincidences in position on the sky between apparent emission nebulae at $|b^{II}| > 10°$ and concentrations of high-velocity gas ($|v| > 100$ km s^{-1}) are reported. (auth)

46251 KINEMATICS OF MOLECULAR CLOUDS NEAR THE GALACTIC CENTER. Scoville, N. Z. (Columbia Univ., New York). Astrophys. J.; 175: No. 3, L127-32(1 Aug 1972).

A model is proposed in which most of the molecular clouds near the galactic center are situated in a radially moving ring of radius 250 pc. (auth)

46252 21 cm OBSERVATIONS OF NGC 45. Lewis, B. M. (Australian National Univ., Canberra). Aust. J. Phys.; 25: No. 3, 315-28(Jun 1972).

Observations of NGC 45 were made at a wavelength of 21 cm using the radio telescope at Parkes. Line profiles were measured for a grid of 44 points spaced at intervals of 6′ arc. From the measurements the mass of neutral hydrogen was calculated to be 8.2×10^9 $M_\odot$, assuming a distance of 3 Mpc. A simple self-consistent model was determined by computing line profiles to compare directly with the observations. This enabled the rotation curve to be corrected for the first-order effects of beam smoothing and resulted in a total limiting mass of 2.5×10^{10} $M_\odot$. (auth)

46253 APPROXIMATE SOLUTIONS OF THE RELATIVISTIC GRAVITATIONAL FIELD EQUATIONS TO DESCRIBE CLUSTERS OF GALAXIES. Cook, M. W. (Univ. of New England, Armidale, Australia). Aust. J. Phys.; 25: No. 3, 299-305(Jun 1972).

Approximate solutions to the Einstein field equations are found that describe a spherically symmetric inhomogeneity in a general Robertson–Walker model, i.e., one with an arbitrary equation of state. The approximation hypothesis is that the pressure deviates only slightly from uniformity, and it is found that the density may have quite large local fluctuations, e.g., by a factor of 10^6 over a region 10^{-2} Mpc in diameter. Reference is made to observed data to determine which categories of stellar objects may be described by the results. (auth)

Cosmology

Refer also to abstracts: 46596, 46749, 46755, 46758, 46759, and 46761.

46254 (COO–1112-51) TIME VARIATION OF THE FINE STRUCTURE CONSTANT AND SPECTRAL LINES FROM QUASI-STELLAR OBJECTS. Tomozawa, Yukio (Michigan Univ., Ann Arbor. Harrison M. Randall Lab. of Physics). Jun 1970. 7p. Dep. NTIS.

It has been suggested that the gravitational constant (G) is likely to be an increasing function of time (ϵ) in the model of an expanding universe. Assuming the $G \propto \epsilon$, the relation $\alpha^{-1} = \frac{3}{2}\pi \ln 1/t +$ constant is obtained, i.e., the fine structure constant (α) is slowly increasing in time. It is pointed out that a more accurate measurement of quasar spectra is needed to test the relation. (W.D.M.)

46255 MEASUREMENT OF THE ISOTROPY OF THE MICROWAVE BACKGROUND TEMPERATURE AT 6-cm WAVELENGTH. Davis, Karl C. Princeton, N. J.; Princeton Univ. (1971). 145p. University Microfilms Order No. 72-13,737.

Thesis.

A survey of the sky brightness was made at 6-cm wavelength for the purpose of measuring the isotropy of the cosmic background radiation. The instrument used had an angular resolution of approximately 5 and measured the apparent sky brightness temperature difference between regions centered on the celestial pole and on points southward to −9.5 declination. The instrument was operated 24 hours a day for approximately one year, thus covering all values of right ascension. Galactic radio emission at 6 cm was estimated using a 75-cm sky survey and a temperature spectral index of −2.8. The results of the 6 cm survey, after subtraction of galactic emission, were examined for several possible anisotropies. Because of a systematic error related to movement of the measuring beam in declination all information about anisotropies having the celestial pole as a symmetry axis was lost. An anisotropy with 24-hour spatial period with amplitude in the equatorial plane of 2.5 ± 1.5 milliKelvin (corresponding to a velocity of the local center of rest with respect to uniform expansion of the Universe of 250 ± 150 km/s) with direction 10 ± 2 hours right ascension was observed. This result is in agreement with previous measurements at 3-cm wavelength. An anisotropy with 12-hour spatial period was observed but was found to depend strongly on a small fraction of the data near the galactic center and is believed not to be a feature of the cosmic background. The data in regions removed from the galactic center was examined for areas of angular diameter 15 and 30 with anomalous temperature. No evidence was found for such regions. Upper limits on the maximum departure from isotropy of 37 milliKelvin for 15 areas and 16 milliKelvin for 30 areas are given with 90% confidence for the area of the sky covered (47% of the total sphere). Details of the experiment and data analysis are given with suggestions for future isotropy measurements. (Diss. Abstr. Int., B)

46256 OBSERVATIONAL COSMOLOGY. Longair, M. S. (Mullard Radio Astronomy Observatory, Cambridge, Eng.). Rep. Progr. Phys.; 34: No. 12, 1125-1248(1971).

While a strong case can be made for the hot model of the universe, many other theories have been proposed which would drastically change this picture. The status of a number of these hypotheses, including alternative theories of gravitation, noncosmological redshifts, steady-state theory, and variations of the constants of nature with epoch, are discussed in the light of recent observations. (auth)

46257 HOT UNIVERSE, COSMIC RAYS OF ULTRAHIGH ENERGY, AND ABSOLUTE REFERENCE SYSTEM. Sato, Humitaka (Kyoto Univ.); Tati, Takao. Progr. Theor. Phys. (Kyoto); 47: No. 5, 1788-90(May 1972).

Interaction of the 3°K cosmic thermal radiation with cosmic particles with $E > 10^{20}$ eV should lead to an attenuation mean-free-path as small as $10^{8.0} \sim 10^{7.3}$ parsec. Analysis of a large air shower has revealed that the energy spectrum of cosmic rays extends smoothly beyond 10^{20} eV. Therefore, the nonexistence of the expected cutoff in the vicinity of 10^{20} eV offers a critical discrepancy between theory and observation. A way is proposed to get rid of this discrepancy. (W.D.M.)

46258 PHYSICAL ASSOCIATIONS BETWEEN QUASI-STELLAR OBJECTS AND GALAXIES. Burbidge, G. R. (Univ. of California, San Diego); O'Dell, S. L.; Strittmatter, P. A. Astrophys. J.; 175: No. 3, 601-11(1 Aug 1972).

Further evidence is presented relevant to apparent associations between galaxies and quasi-stellar objects. It is shown that for the five 3C QSOs which lie very close to bright galaxies the QSO–galaxy angular separations are inversely proportional to the redshifts of the galaxies. This lends additional support to the association hypothesis. However, an analysis of an essentially disjoint sample of QSOs identified from the Parkes radio catalog, and fainter galaxies in the catalog of Zwicky and his associates, reveals no statistically significant tendency toward pairing of QSOs and galaxies. The results can be explained in one of two ways. One is that, despite the evidence to the contrary, the 3C results are due to chance. The other is that real associations in the second sample are masked by selection effects. It is shown that several selectional biases do indeed discriminate against the detection of QSO–galaxy pairs, especially for fainter objects. Finally, on the assumption that the 3C QSO–galaxy associations are real, the relationship of QSOs to galaxies is discussed. (auth)

46259 MASS DIFFERENCE OF THE MUON AND THE ELECTRON. Hoyle, F.; Narlikar, J. V. (Cambridge Univ., Eng.). Nature (London); 238: No. 5359, 86-7(14 Jul 1972).

It is stated that the fact that the muon and the electron have different masses can be understood in terms of a Machian theory of inertia. The masses of particles are not fixed and immutable but depend on the detailed particle composition of the Universe. (auth)

46260 CAN THE LUMPY DISTRIBUTION OF GALAXIES BE DETECTED BY X-RAY OBSERVATIONS. Webster, A. S. (Univ. of California, Berkeley). Nature (London); 238: No. 5358, 20-4(7 Jul 1972).

It is stated that published data from x-ray telescope observations are not adequate to reveal the fluctuations in the surface brightness of the background radiation caused by clustering or superclustering of the sources giving rise to the background. (auth)

46261 HOMOGENEOUS ROTATING UNIVERSE WITH FLAT SPACE. Demianski, M. (Univ., Warsaw); Grishchuk, L. P. Commun. Math. Phys.; 25: No. 3, 233-44(1972).

The homogeneous, anisotropic cosmological model is considered. It satisfies three physically reasonable conditions: it is space homogeneous, possesses flat space-like sections, and is filled with expanding, rotating, and shearing matter. The asymptotic solution is presented and general properties are discussed. The question how the rotation influences the behavior of matter near the singularity is investigated. (auth)

Planetary Phenomena

Refer also to abstract: 47016.

46262 POSSIBLE PRODUCTION MECHANISMS OF LUNAR MAGNETIC FIELDS. Cap, Ferdinand F. (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res.; 77: No. 19, 3328-33 (1 Jul 1972).

The impossibility of the production of local surface magnetic fields on the Moon by conduction currents in the lunar soil and in local lunar atmospheres by volcanic eruption is shown. However, it is suggested that convection currents produced by the ionization (by radiation and/or by triboelectric effects) of volcanic-ash–particle flows may produce the local magnetic fields of about 1000 γ that are believed to have existed on the Moon about 3.5×10^9 years ago. A simple electrogasdynamic model for such flows and experiments for further investigation of this hypothesis are discussed. (30 references) (auth)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

46263 (AD–734392) METHOD FOR RAPID COMPUTATION OF VLF, STEEP-INCIDENCE REFLECTIONS FROM THE IONOSPHERIC D REGION. Research and Development Report, October 1970–June 1971. Hill, J. R. (Naval Electronics Lab. Center, San Diego, Calif.). 19 Aug 1971. 25p. (NELC-TR–1784. NTIS.

A method for the rapid computation of coefficients for vlf reflections from the ionospheric D region is described. Previously calculated wave-field solutions are used to compute reflection coefficients for new electron-density profiles. The usefulness of the method is demonstrated by a study of several D-region profiles. The study shows the sensitivity of the reflection coefficients to small changes in the profiles. Experience indicates that three to six times as many profiles can be examined in a parametric study than was previously possible for a given computer cost. The resulting increase in computational speed greatly facilitates parametric studies of electron-density profiles. (auth)

46264 (COO–2195-5) CORRELATION OF D-REGION ABSORPTION AND THE 10 mb WINDS AND TEMPERATURE DURING THE IQSY. Wu, Mao-Fou; Newell, Reginald E. (Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology). [nd]. Contract AT(30-1)-2241. 18p. Dep. NTIS.

Relations between absorption and some meteorological parameters were studied for the entire period of the IQSY. The method is to calculate the correlation coefficient between the D-region hf radio-wave absorption at local noon and 10-mb level winds and temperature at 12 Z for nine stations in the Northern Hemisphere. Results show that the absorption correlates negatively with the zonal wind (positive toward east), but positively with the temperature for the majority of cases, and that the meridional wind (positive toward north) is correlated with absorption in the winter season. It is suggested that the northward transport of atomic oxygen by large-scale eddies is related to the winter D-region abnormal absorption and some correlations with airglow data are presented to support this suggestion. (auth)

46265 (N–72-18715) OGO-1 AND OGO-3 MIT PLASMA EXPERIMENTS S4903. Final Project Report. (Massachusetts Inst. of Tech., Cambridge. Center for Space Research). 30 Jun 1968. Contract NAS5-2053. 208p. (NASA-CR–122351). NTIS.

Plasma proton and plasma electron prototype and flight models were designed, fabricated, and tested. Ground-support equipment for the models was also prepared. The flight models were launched aboard the first and third Orbiting Geophysical Observatories on Sept. 4, 1964 and June 6, 1966. These experiments have generally functioned in accordance with the design specifications and useful data are still being received. (STAR)

46266 CRITICAL COMPONENT OF THE INTERPLANETARY MAGNETIC FIELD RESPONSIBLE FOR LARGE GEOMAGNETIC EFFECTS IN THE POLAR CAP. Friis-Christensen, E. (Danish Meteorological Inst., Charlottenlund, Denmark); Lassen, K.; Wilhjelm, J.; (and others). J. Geophys. Res.; 77: No. 19, 3371-6(1 Jul 1972).

An observed influence of the interplanetary magnetic-sector structure on the geomagnetic variations in the polar cap appears to be due to the component of the interplanetary magnetic field near the ecliptic perpendicular to the Earth–Sun direction. This suggests that the observed effect on the ground originates in the front of the magnetosphere. (auth)

46267 FERMI ACCELERATION OF AURORAL PARTICLES. Sharber, J. R.; Heikkila, W. J. (Univ. of Texas, Dallas). J. Geophys. Res.; 77: No. 19, 3397-3410(1 Jul 1972).

A number of nighttime acceleration mechanisms proposed in the literature are reviewed and rejected for the role of producing the key nighttime auroral-particle fluxes. Parallel electric fields are rejected for several reasons, but particularly because of the observed simultaneous precipitation of electrons and protons. Acceleration in the neutral sheet is inadequate for producing the particle energies, the observed field-aligned pitch-angle distribution at high latitudes, and the spectral hardening toward lower latitudes. Neutral-point mechanisms, although often suggested in principle, have never been demonstrated satisfactorily in theory or in practice. Pitch-angle scattering from a trapped population produced by transverse adiabatic compression is also incapable of producing the field-aligned distribution. Possibly longitudinal or Fermi acceleration, which results from the known magnetospheric convection, is the main nighttime auroral acceleration mechanism. The argument is supported by data obtained with the soft-particle spectrometer of Isis 1. In particular, the rotational scanning provided by the spinning satellite shows the regular change from a field-aligned pitch-angle distribution at high latitudes to a trapped distribution at low latitudes, reflecting a change from Fermi acceleration on the distant taillike field lines to betatron acceleration on the more dipolar field lines closer to the Earth. The operation of the Fermi mechanism requires multiple bounces between hemispheres, and therefore a loss cone must develop at both 0° and 180°; such distribution is shown by the Isis 1 data when the range of the pitch-angle scan is sufficiently wide. One other feature is evident in the data: a hardening of the spectrum at small pitch angles. This energy-dependent pitch-angle distribution has a characteristic signature on the energy-time spectrograms that is designated as a Λ structure; when both loss cones show, the characteristic signature is a topless Λ structure. Adiabatic compression thus plays a vital role in auroral and magnetospheric substorms; longitudinal or Fermi acceleration causes auroral-particle precipitation, whereas transverse or betatron acceleration is responsible for lower-latitude phenomena, such as the ring current. (45 references) (auth)

46268 OBSERVATIONS OF THE AURORAL OVAL BY THE ALASKAN MERIDIAN CHAIN OF STATIONS. Snyder, A. L.; Akasofu, S.-I. (Univ. of Alaska, College). J. Geophys. Res.; 77: No. 19, 3419-30(1 Jul 1972).

The Alaskan meridian chain of stations "scans" the polar sky like an azimuth scan radar once a day between the corrected geomagnetic latitudes of 60° and 85°N. The all-sky photographs from the chain of stations have provided and clarified several important features of auroral morphology, in particular the dynamics of the night-sector auroral oval. Results are summarized. (41 references) (auth)

46269 THERMOSPHERIC MOLECULAR OXYGEN FROM SOLAR EXTREME-ULTRAVIOLET OCCULTATION MEASUREMENTS. Roble, R. G.; Norton, R. B. (National Center for Atmospheric Research, Boulder, Colo.). J. Geophys. Res.; 77: No. 19, 3524-33(1 Jul 1972).

The molecular-oxygen number density distribution in the 95- to 120-km region of the atmosphere has been determined from solar-occultation measurements made by the Solrad-8 satellite. The solar intensity in the region 1040 to 1350 A was monitored by a photometer aboard the satellite during occultation of the Sun by the Earth. The bulk of the energy in the wavelength interval lies in Lyman α, which is primarily absorbed by molecular oxygen. Therefore the solar-occultation measurements are directly inverted to give the number density distribution of molecular oxygen at the occultation tangent point. The data from 93 occultation scans obtained at midlatitudes and high latitudes in both hemispheres from December 1, 1966, to August 31, 1967, are presented. The results show a seasonal variation of molecular oxygen in the lower thermosphere. In general, the molecular-oxygen number density distribution in the summer is approximately 3 times greater than that in the winter. (47 references) (auth)

46270 GEOMAGNETIC EFFECT ON THE NEUTRAL TEMPERATURE OF THE F REGION DURING THE MAGNETIC STORM OF SEPTEMBER 1969. Blamont, J. E.; Luton, J. M. (CNRS, Verrieres-le-Buisson, France). J. Geophys. Res.; 77: No. 19, 3534-56(1 Jul 1972).

A spherical Fabry–Perot interferometer on Ogo 6 (launched June 5, 1969) gives the profile of the 6300-A oxygen line in the dayglow at different altitudes between 200 and 320 km. The temperature of the neutral components of the atmosphere is deduced from these measurements with an accuracy of ±65°K. The results presented correspond to the storm period September 25 to October 5, 1969. During this period a severe geomagnetic storm occurred. The temperature measurements show a very strong effect in the two polar regions, while the equatorial regions present a smooth temperature variation. (auth)

46271 ANALYSIS OF OGO 6 OBSERVATIONS OF THE O I 5577-A TROPICAL NIGHTGLOW. Thomas, R. J.; Donahue, T. M. (Univ. of Pittsburgh). J. Geophys. Res.; 77: No. 19, 3557-65 (1 Jul 1972).

Atomic oxygen green-line data from the horizon scanning photometer on Ogo 6 were examined. Unfolding the satellite data from the tropical F region yields altitude and latitude variations of the $O(^1S)$ emissions. The spatial variations of the tropical F-region electron density are then calculated by assuming dissociative re-

combination and using a model atmosphere. Where comparisons to ground-based data are possible, the results are good. Thus, the satellite observations constitute a form of topside sounding of the ionosphere below the F peak and provide synoptic data about this portion of the ionosphere that are otherwise impractical to obtain. (auth)

46272 COLLISIONAL LOSSES IN A VERY-LOW FREQUENCY DUCT ASSOCIATED WITH THE LOWER-HYBRID-RESONANCE FREQUENCY. Gross, S. H. (Polytechnic Inst. of Brooklyn, Farmingdale, N. Y.). J. Geophys. Res.; 77: No. 19, 3589-91 (1 Jul 1972).

Calculations of loss in a multi-ion horizontal duct that may trap and guide vlf waves indicate that losses are small for some configurations and not for others. Under appropriate conditions signals can be guided horizontally for hundreds of kilometers without excessive attenuation. (auth)

46273 NUMERICAL EVALUATION OF CHAPMAN'S GRAZING INCIDENCE INTEGRAL CH (X, chi). Smith III, F. L.; Smith, Cody (Colorado State Univ., Fort Collins). J. Geophys. Res.; 77: No. 19, 3592-7(1 Jul 1972).

A formula that is both numerically convenient to use and accurate to within 2% for all χ when $X > 50$ may be used to approximate ch (X, χ). The approximation may be applied to optical-depth calculations in nonexponential models of the terrestrial atmosphere, the resulting errors still remaining smaller than 4% for most ionospheric applications. (auth)

46274 RELATIONSHIP BETWEEN Pc 1 MICROPULSATIONS AND IONOSPHERIC SPREAD F. Fraser-Smith, A. C. (Stanford Univ., Calif.). J. Geophys. Res.; 77: No. 19, 3602-6(1 Jul 1972).

Simultaneous micropulsations and ionosonde records obtained on the Stanford campus were compared for the 18-month interval from Jan. 1, 1970 through June 30, 1971 to study the relationship between spread F and the Pc 1 micropulsations. The 73 simultaneous observations were made at night. There was evidence for both an increase in the frequency of occurrence and in the strength of ground-recorded Pc 1 when spread F was present in the overhead ionosphere. A tendency was present for Pc 1 to occur most often in the time interval most favorable for spread F, although no correlation was found between the observed durations of associated activity. During the 18-month interval, occurrences of Pc 1 and spread F reached peaks simultaneously at 0100 to 0400 LST. Possible evidence for a correlation between Pc 1 and spread F also is provided by long-term observations made separately on their solar-cycle variations. (J.C.W.)

46275 SATELLITE AND GROUND-BASED OBSERVATIONS OF A RED ARC. Nagy, A. F. (Univ. of Michigan, Ann Arbor); Hanson, W. B.; Hoch, R. J.; Aggson, T. L. J. Geophys. Res.; 77: No. 19, 3613-17(1 Jul 1972).

Simultaneous observations were performed during the red-arc period of Aug. 8–9, 1970. Photometric observations were made near Richland, Washington and Ogo 6 obtained data in the southern hemisphere. The formation of the arc at the electron-temperature peak and density trough supports the thermal-conduction theory of red-arc formation. The lack of the dc electric fields in the red-arc region ruled out dc electric fields as an excitation mechanism; particle precipitation as a direct source of the red-line emission can also be ruled out by the observations made. The formation of the arc in the plasmapause region and the detection of low-frequency ac fields are consistent with a theory that predicts wave–particle interactions at the plasmapause as a mechanism for supplying thermal energy to the plasmasphere electrons. (J.C.W.)

46276 $H\beta/N_2^+$ 4709-A INTENSITY RATIO AND VIBRATIONAL ENHANCEMENT OF N_2^+ FIRST NEGATIVE BANDS IN PROTON-EXCITED AURORAS. Degen, V.; Belon, A. E.; Romick, G. J. (Univ. of Alaska, Fairbanks). J. Geophys. Res.; 77: No. 19, 3618-20(1 Jul 1972).

The N_2^+ first negative band system was examined for a possible vibrational enhancement that may be expected to occur in auroras excited by low-energy (<10 keV) protons. Vibrational enhancement has been well documented only in certain large auroras, but the role of protons in inducing anomalous vibration is still controversial because of possible contamination of the spectra by O II and other uncertain excitation conditions. Observational data are discussed concerning the faint aurora, also known as the hydrogen arc. Theoretical estimates made by Omholt (1971) and based on uncertain cross sections give $H\beta/N_2^+$ 4709-A intensity ratios in a pure proton-excited aurora ranging from 1.25 for protons with an initial energy of 100 keV to about 10 for 3-keV protons. Eather's 1967 earlier calculations gave ratios of 1 to 2.5 for this energy range. A search by Eather (1968) for maximum ratios in nightside auroras using a multichannel tilting filter photometer led to a statistical value for a maximum ratio of about 1.1 to 0.8. Eather suggests a ratio of about 1 as a working criterion for a nighttime proton-induced aurora. Such auroras are subvisual or marginally visual. Ratios as high as 3 have been reported in extremely faint (<10 rayleighs in $H\beta$) dayside auroras. (J.C.W.)

46277 NONLINEAR SATURATION OF TYPE-I IRREGULARITIES IN THE EQUATORIAL ELECTROJET. Weinstock, Jerome; Sleeper, Arthur (National Oceanic and Atmospheric Administration, Boulder, Colo.). J. Geophys. Res.; 77: No. 19, 3621-4 (1 Jul 1972).

A nonlinear theory is presented for the saturation of the type-1 equatorial E-layer instability. Saturation is achieved by the transfer of wave energy to electrons (electron trapping). The irregularity is found to be about 2% of the background density. Formulas are derived for both the particle density and the electric field of the irregularity. (auth)

46278 DETERMINATION OF THE QUENCHING OF $O(^1D)$ BY MOLECULAR NITROGEN USING THE IONOSPHERIC MODIFICATION EXPERIMENT. Hernandez, G. (National Oceanic and Atmospheric Administration, Boulder, Colo.). J. Geophys. Res.; 77: No. 19, 3625-9(1 Jul 1972).

The collisional frequency of quenching of $O(^1D)$ by molecular nitrogen is derived from measurements of the lifetime of O I 6300-A emission during the transient disturbances created by the ionospheric modification experiment (IME). The mean value obtained for the frequency of quenching (at 120 km) is 18 sec^{-1}, the spread being 17 to 20 sec^{-1}. The corresponding reaction rate coefficient is $9(^{+1.0}_{-0.8}) \times 10^{-11}$ cm^3 sec^{-1}, based on the model atmosphere used, and is in excellent agreement with recent laboratory and aeronomical determinations. (auth)

46279 INVESTIGATION OF THE IONOSPHERIC D REGION AT SUNRISE. I. TIME VARIATIONS OF OZONE, METASTABLE MOLECULAR OXYGEN, AND ATOMIC OXYGEN. Turco, R. P.; Sechrist, C. F. Jr. (Univ. of Illinois, Urbana). Radio Sci.; 7: No. 7, 703-16(Jul 1972).

As a step in determining the behavior of the D-region ionization at sunrise, the development of atomic oxygen and ozone over sunrise was investigated, taking into account the absorption of solar ultraviolet radiation by the time-varying, nonuniform ozone distribution over the mesosphere at sunrise. The dissociation rates of ozone and molecular oxygen are calculated and used to determine the time variations in the O and O_3 densities at sunrise for a model considering only the oxygen allotropes. Transport processes were neglected in the sunrise calculations because chemical time constants are shorter than those for transport. However, the assumed initial presunrise atomic oxygen and ozone distributions, based on an average of theoretical and experimental results, do include the effects of transport. It was found that at altitudes from 60 to 80 km there is a delay in the ozone sunrise, and thus a delay in the development of the atomic oxygen density. $[O]/[O_3]$ was computed during sunrise, and a similar delay in its sunrise increase was observed. The production of metastable oxygen $O_2(^1\Delta_g)$ by the photodissociation of ozone in the Hartley band at sunrise was also investigated. A simplified chemical scheme for $O_2(^1\Delta)$ is presented, from which a closed-form solution for the $O_2(^1\Delta)$ densities over sunrise was obtained. $O_2(^1\Delta)$ may be important in the ion chemistry at sunrise, and can contribute to the early appearance of electrons in the D region. (auth)

46280 INVESTIGATION OF THE IONOSPHERIC D REGION AT SUNRISE. II. ESTIMATION OF SOME PHOTODETACHMENT RATES. Turco, R. P.; Sechrist, C. F. Jr. (Univ. of Illinois, Urbana). Radio Sci.; 7: No. 7, 717-23(Jul 1972).

The photodetachment rates of several negative ions believed to be present in the D region are estimated for sunrise conditions. The photodetachment cross sections of O^- and O_2^- which have been measured in the visible and infrared wavelength ranges are used. Since the photodetachment cross sections of NO_2^- and NO_3^- are not yet known, the behavior of their rates could only be estimated. Infrared band absorption by H_2O and CO_2 is included in the calculations. For atoms and molecules with large electron affinities, the ozone ultraviolet absorption is important. The effects of photodetachment on D-region behavior are discussed and found to be relatively unimportant. (auth)

46281 INVESTIGATION OF THE IONOSPHERIC D REGION AT SUNRISE. III. TIME VARIATIONS OF NEGATIVE-ION AND ELECTRON DENSITIES. Turco, R. P.; Sechrist, C. F. Jr. (Univ. of Illinois, Urbana). Radio Sci.; 7: No. 7, 725-37(Jul 1972).

The growth over sunrise of the C and D layers of the ionosphere is investigated for a model which includes: the negative ion species O^-, O_2^-, O_3^-, O_4^-, NO_2^-, NO_3^-, CO_3^-, and CO_4^-; ion-pair production by galactic cosmic rays, precipitated electrons, photoionization of NO by scattered Lyman-α radiation, and the photoionization of NO and

$O_2(^1\Delta)$ by direct solar radiation; the photodetachment of most of the negative ions; and the time variations of all these parameters. It is found that the inclusion of the reaction $NO_3^- + O \rightarrow NO_2 + O_2^-$ with a rate constant of 5×10^{-14} cm^3 sec^{-1} in combination with fast electron-ion recombination ($\alpha \sim 10^{-5}$ cm^3 sec^{-1}) can accurately reproduce both the development of the C layer at sunrise and the correct magnitude and form for the D-layer development. The photodetachment of NO_3^- is not a suitable alternate source of sunrise electrons because of the large electron affinity of NO_3. The photodetachment of lower-affinity negative ions, such as hydrated species, could replace the $NO_3^- + O \rightarrow NO_2 + O_2^-$ reaction if indeed the presunrise mesospheric ions are predominantly hydrated. The dominant ions in the present scheme are NO_3^-, CO_4^-, and CO_3^-. Atomic oxygen greatly limits the quantity of negative ions above 75 km at all times of the day by associative detachment and is responsible for the night-time D-layer ledge of electron density. The 98 and 94° VLF radio propagation effects are explicable on the basis of this model. (auth)

46282 SYNTHESIS OF JICAMARCA DATA DURING THE GREAT STORM OF MARCH 8, 1970. Woodman, Ronald F. (Jicamarca Radar Observatory, Lima); Sterling, D. L.; Hanson, W. B. Radio Sci.; 7: No. 7, 739-46(Jul 1972).

Continuous measurements of electron temperature and electron concentration were made at Jicamarca from 0700 to 0830 LT and from 1130 to 2000 LT during the great magnetic storm of March 8, 1970, when the F2 peak rose as high as 800 km. Continuous measurements of the vertical component of E × B drift were made from 1130 to 1730 LT. A synthesis of the observed electron concentrations was made using a model that solved the time-dependent electron-ion continuity equation for O^+ and the molecular ions; the latter chemistry was included to improve the solutions at lower heights. It was found, using the observed values of vertical drift, that most of the observed features of the F2 region ionosphere were synthesized by the model. An interpretation of the synthesis that emphasizes the importance of horizontal diffusion at the equator is given. Observations are presented for March 7, 8, and 9, 1970, including the Huancayo magnetograms, which display a close correlation with the drift measurements. (auth)

46283 CHATANIKA, ALASKA, AURORAL-ZONE INCOHERENT-SCATTER FACILITY. Leadabrand, R. L. (Stanford Research Inst., Menlo Park, Calif.); Baron, M. J.; Petriceks, J.; Bates, H. F. Radio Sci.; 7: No. 7, 747-56(Jul 1972).

The operational status of an auroral-zone incoherent-scatter radar is discussed. The Stanford Research Institute 1290-MHz incoherent-scatter radar, which was moved to Chatanika, Alaska (L = 5.7), an auroral-zone location near Fairbanks, is now producing interesting new results. The siting of the radar is such that D-, E-, and F-region incoherent-scatter measurements can be made without ground-clutter interference. Although coherent auroral-clutter echoes can at times be seen at relatively low elevation angles in the north, auroral echoes are sufficiently weak at 1290 MHz in the sidelobes of the antenna that they are not detectable during normal incoherent-scatter measurements. The capabilities of the radar system are outlined, and samples are presented of the type of incoherent-scatter results being obtained. (auth)

46284 RING CURRENT EFFECT ON MAGNETOSPHERIC ELECTRON DENSITY PROFILES DERIVED FROM PLASMAPAUSE WHISTLERS. Mathur, A. (Univ. of Southampton, Eng.); Rycroft, M. J.; Sagredo, J. L. Nature (London); 237: No. 5357, 508-10(30 Jun 1972).

It is stated that the longitudinal drift of Van Allen radiation belt charged particles, with opposite charges drifting in opposite directions in the geomagnetic field, constitutes a westward directed ring current at a distance of several Earth radii, and although at magnetically quite times this current neither reduces to the geomagnetic field nor affects the parameters that determine the group velocity of a whistler mode-signal propagating along a particular field line, these can be changed significantly at magnetically active times, such as during the main and recovery phases of a magnetic storm, where the ring current is stronger. The assumption that is conventionally made when deriving magnetospheric electron density profiles from whistlers, that the Earth's magnetic field is a perfect dipole, is valid during magnetically quiet periods, and electron density profiles exhibiting the plasmapause have thus been deduced from whistlers at times of both very high and low planetary magnetic index. During geomagnetic storms, however, the enhanced ring current reduces the equatorial magnetic field strength and so reduces the electron gyrofrequency and the nose frequency of a whistler propagating along a field line that passes through a particular point on the Earth's surface; it is necessary, therefore, to include both the distortion of the field line due to the ring content and the change of the whistler mode refractive index when determining the equatorial density along the actual path of propagation. Results are given that show quantitatively the effect of the ring current perturbation to the geomagnetic field on whistler propagation near the plasmapause. The ring current effect was pronounced outside the plasmapause, noticeable on the plasmapause, and insignificant within the plasmasphere. Also, when the effect of a ring current is allowed for, the electron density charge at the plasmapause is increased, making the plasmapause an even more noticeable feature of the distribution of thermal plasma in the magnetosphere. (UK)

46285 VLF EMISSIONS DURING POST BREAKUP PHASE OF POLAR SUBSTORM. Hayashi, Kanji; Kokubun, Susumu (Tokyo Univ.). Rep. Ionosphere Space Res. Jap.; 25: No. 4, 369-82(Dec 1971).

Fine structures of vlf emissions during substorms are examined, using data obtained at Syowa Station in Antarctica. It is found that a special type of chorus emission, denoted here by auroral chorus, is observed during the maximum or recovery phase of substorm. The spectral structure of auroral chorus is quite different from that of daytime polar chorus. Rising elements with duration of about 0.2 second intermittently appear in a group of several seconds' duration and the interval between these groups is usually of the order of ten seconds. The whole event lasting about 40 minutes consists of short sequences of risers' groups overlapping in time in a frequency of 0.5–2 kHz. These characteristic time scales of chorus emissions during substorms are almost in agreement with those of pulsating auroras, suggesting a common origin for the energetic electron precipitation that causes pulsating aurora. (auth)

46286 OBSERVATION OF THE INTENSITY RATIO BETWEEN (5,1) AND (9,4) BANDS OF OH EMISSION IN THE NIGHT AIRGLOW. Yano, Kyo; Takahashi, Hisao (Niigata Univ., Japan). Rep. Ionosphere Space Res. Jap.; 25: No. 4, 301-16(Dec 1971).

Observations were made of the intensity ratio of (5, 1) to (9, 4) bands of OH emission in the nightglow from November 1968 to October 1969 with an interference filter tilting photometer. The methods of evaluating the ratio from photometer readings are described. About 245 values of the ratio were obtained on 25 clear nights in the twelve months, scattering around 1.7 with the maximum of 2.1 and the minimum of 1.4. Although some consistency of its monthly variation was found, no regularity such as seasonal variation could be ascertained. It was revealed that on more than half of the observed nights the ratio was roughly constant in the course of night except in twilight conditions, while a nocturnal change from 1.4 up to 2.1 was observed on several occasions. These results are interpreted in terms of the vibrational population of OH molecules in the ground state. It is suggested that the OH molecules in the upper atmosphere could be produced through various kinds of chemical reactions with different amounts of energy being released, and that there might be a change in the rate of each reaction contributing to the OH formation with a characteristic time of only a few hours duration. (auth)

46287 ELECTRON CONTENT OF THE IONOSPHERE, SOLAR, AND GEOMAGNETIC ACTIVITY. Ebel, A. (Univ., Cologne). Gerlands Beitr. Geophys.; 81: No. 1-2, 11-20(1972). (In German).

Observations of the ionospheric electron content N_T made at several stations of low and middle latitudes were analyzed with respect to solar and geomagnetic activity. The data cover the period 1965–1968. The coefficients of the regression equation $N_T = c_0 + c_S \cdot S + c_{AP} \cdot A_p$. S (flux of the solar 10.7-cm radiation) and A_p (geomagnetic-activity index) were computed for each month of the year and several hours of the day as far as data were available. The results show a clear semiannual variation of the coefficient c_S at all stations at noon and a systematic seasonal variation of c_{AP} with a minimum in summer and a maximum in winter at higher latitudes, whereas c_{AP} varies irregularly at lower latitudes. The night-time value of c_S reaches a maximum in summer or late spring at all stations with the exception of the equatorial one. The daily amplitude of c_S is smaller during summer than during winter. A comparison with a similar analysis of $(f_0F2)^2$ shows that the electron content depends on the geomagnetic activity in a different way than does the maximum electron density. It should be noted that the coefficient c_0 of the regression equation nearly vanishes for all months and stations. The different dependence of the electron content on solar and geomagnetic activity, respectively, explains several observed peculiarities of the variation of N_T during one solar cycle, for instance the hysteresis effect, i.e. higher values during the descending than the ascending part of the solar cycle. The seasonal anomaly can be described by the coefficient c_{AP} for the higher latitudes. The semiannual and seasonal variations of c_S and c_{AP} are supposed to reflect various transport properties of the thermosphere with respect to the ion-

ized component. This may be a meridional transport shifting of the plasma from low to high latitudes during the equinoxes, thus producing a semiannual variation. On the other hand, the possible influence of a prevalent zonal wind system—superimposed on the daily wind variations in the thermosphere at middle and high latitudes—allows explanation of the changes of c_{AP} observed at the northern stations. (tr-auth)

46288 MODEL STUDIES OF DENSITY FLUCTUATIONS OF SMALL AND LARGE IONS IN THE ATMOSPHERE. Lundquist, S.; Murty, R.; Rosen, V.; Scuka, V. (Institutet foer Hoegspaenningsforskning, Uppsala). Phys. Scr.; 4: No. 6, 293-6(1971).

A simplified theoretical model for atmospheric ions has been used to study the variation of small-ion production rate. Linear equations have been derived to study the fluctuations of small and large ion concentrations with time. It is found that no oscillating solutions are possible. Using Bendixon's theorem it is shown that the same conclusion holds for the nonlinear equations. The conclusions have been compared with the results of other workers. (auth) (Sweden)

46289 SMALL-SCALE FLUCTUATIONS IN THE F-REGION CRITICAL FREQUENCY OBSERVED AT DELHI. Setty, C. S. G. K.; Gupta, Anurag B. (Univ. of Delhi). Indian J. Pure Appl. Phys.; 10: No. 2, 161-3(Feb 1972).

Accurate measurements of small fluctuations of F-region critical frequency have been made over a period of one year. Spectral analysis of these records shows periodic fluctuations in F-region critical frequency of periods between 10 and 100 min falling in the range of acoustic-gravity waves in the ionosphere with a sharp lower cutoff period in the neighborhood of 10 min. The mean amplitude in this range is of the order of 50 ± 10 kHz. As the height of reflection at the peak of the F-layer changes with season, the lower cutoff period of the spectral components is found to increase with the increase of height. It is also noted that the optimum period is in the range 24 to 30 min depending on height and that the total rms deviation of electron density is about 0.5%. Also, a preliminary study has been made to yield apparent horizontal and vertical velocity components in the plane of the magnetic meridian using the radio-ray tracing and the cross-correlation techniques. (auth)

46290 LARGE SCALE PERIODIC DISTURBANCES IN THE IONOSPHERE. Basu, S.; Guhathakurta, B. K. (University Coll. of Tech., Calcutta). Indian J. Pure Appl. Phys.; 10: No. 2, 164-6(Feb 1972).

Beacon satellite observations, carried out at Haringhata Field Station (geographic lat: 22°58′N, long: 88°30′E, Magnetic dip: 32°N) of the University of Calcutta, indicate the presence of large-scale irregularities of electron density, periodic on a spatial scale. These ionospheric disturbances occurring during summer months over the post-midnight period are often associated with anomalous nighttime gradients of electron density. Under such circumstances the spatial wavelengths are found to change suddenly from low to high wave numbers. (auth)

46291 COUPLING BETWEEN THE IONOSPHERE AND THE PROTONOSPHERE AND ITS IMPLICATIONS ON THE LONG-TERM VARIATIONS OF IONOSPHERIC ELECTRON CONTENT. Waldman, Helio. Stanford, Calif.; Stanford Univ. (1972). 185p. University Microfilms Order No. 72-16,812.

Thesis.

Recent experimental determinations of the flux of ionization between the ionosphere and the protonosphere have indicated that, during the day, the plasma will often flow upwards at a rate that by far exceeds the previously calculated theoretical limit of that flux. The theory of the coupling between the two layers is re-examined in the light of the new evidence, and the discrepancy is shown to be probably due to a previous underestimation of the neutral hydrogen concentrations in the thermosphere. In the upper F region, where diffusion dominates the behavior of the ionospheric oxygen ions, there is a maximum velocity with which such ions can flow upwards. This fact, combined with the condition of photochemical equilibrium prevailing in the lower ionosphere, gives rise to the existence of a limiting upward flux of oxygen ions from the ionosphere. In the topside ionosphere, a similar situation occurs with the protons: up to a certain height they are under chemical equilibrium, and above, they can escape upwards at a rate that is limited by collisions with the oxygen ions, the dominant charged species. Consequently, a maximum proton flux also exists, which limits the rate at which ionization can be transferred from the ionosphere to the protonosphere. Such flux is controlled by the abundance of oxygen ions in the topside ionosphere, which in turn is strongly dependent on the upgoing flux of this species. For continuity reasons, the flux of oxygen ions coming from the bulk of the F region must match the flux of protons escaping the ionosphere. It is shown that, on account of these simultaneous relationships, the limiting exchange flux cannot be properly determined from a fixed model of the F region (as has been attempted in the past) particularly when the resulting flux value is comparable with the limiting upward flux of oxygen ions in the ionosphere. In order to circumvent this difficulty, a self-consistent limiting proton flux is derived. The effect of the exchange flux on the daytime ionosphere is studied. The long-term variations in the daytime exchange flux are estimated with the use of model hydrogen concentrations based on the well-known inverse relationship between the abundance of neutral hydrogen and the neutral temperature in the thermosphere. The present work also includes a review of the basic processes occurring in the ionosphere, with emphasis on the concepts of limiting velocity and limiting flux. In addition, an approach to the problem of numerical simulation of the ionosphere is presented and discussed. (TSS) (Diss. Abstr. Int., B)

46292 OPTICAL DETECTION OF RADIO-FREQUENCY HEATING OF ELECTRONS IN THE F REGION. Sipler, Dwight Passmore. Pittsburgh; Univ. of Pittsburgh (1971). 94p. University Microfilms Order No. 72-17,098.

Thesis.

Heating of the electrons in the F region of the ionosphere by a high-power beam of radio-frequency energy was detected by observation of attendant effects on the intensity of the 6300-Å line of the atomic-oxygen nightglow. Collisional absorption of rf energy propagated in the extraordinary mode produces a small (few percent) transient suppression of the intensity of the 6300-Å line as a result of the decrease in the dissociative recombination production of $O(^1D)$ atoms with increasing electron temperature. The magnitudes of the observed intensity suppression signals are consistent with electron temperature increases in the range 8 to 35%. A plasma instability triggered by the high-intensity rf fields propagated in the ordinary mode was observed to cause large increases in the 6300-Å line intensity by direct electron impact excitation of the ^1D state of atomic oxygen. Measurements of the time constants of these intensity changes have enabled an in-situ determination of the quenching coefficient for the $O(^1D)$ state assuming the quenching is due to N_2. A value $k_q = (5 \pm 2) \times 10^{-11}$ $cm^3\ sec^{-1}$ has been obtained by this method. (Diss. Abstr. Int., B)

46293 DAILY VARIATION OF THE IONOSPHERIC F2 EQUATORIAL ANOMALY IN THE AMERICAN AND ASIAN SECTORS. Anderson, David Nels. Boulder, Colo.; Univ. of Colorado (1971). 157p. University Microfilms Order No. 72-17,231.

Thesis.

When observed noontime values of the maximum electron density in the ionospheric F2 region are plotted as a function of magnetic latitude, a curve is produced that has two peaks, one on either side of the dip equator at ±16° dip latitude. A theoretical investigation is made of the daily variation of the latitudinal distribution in NMAX(F2) (the so-called Appleton or equatorial anomaly) and specifically attempts to account for the longitudinal differences observed between the American and Asian sectors. Solution of the time-dependent electron continuity equation yields the electron density. Since the coefficients are complicated functions of space and time, the equation is solved numerically. Production, loss, and transport of ionization are taken into account, where the effects of neutral wind, ambipolar diffusion, and $\bar{E} \times \bar{B}$ drift are included in the transport term. By describing the magnetic field in two equivalent ways $\bar{B} = -\nabla\gamma$ and $\bar{B} = \nabla\alpha \times \nabla\beta$, where α, β, and γ are known magnetic scalar potentials, it is possible to transform the spherical r, θ, and ϕ space coordinates of the continuity equation to coordinates that define directions parallel and perpendicular to the magnetic field thus putting the equation in a form suitable for numerical integration. For each of the two sectors, results are presented indicating the extent to which the equatorial anomaly's daily variation is affected by changes in the geomagnetic field configuration, neutral wind, and $\bar{E} \times \bar{B}$ drift. It is found that development of the anomaly is most sensitive to the electric-field model assumed. When NMAX(F2) is plotted as a function of local time at the magnetic equator, the observed differences between the American and Asian sectors can be accounted for by an upward $\bar{E} \times \bar{B}$ drift that commences two hours earlier in the Asian. Other investigations includes the effects of the neutral wind in producing north–south asymmetry in the anomaly; the solar-cycle effect on the anomaly's daily variation; and the comparison of results between the centered tilted dipole approximation and the real magnetic field to estimate the differences introduced by the approximation. (Diss. Abstr. Int., B)

46294 CHARGED-PARTICLE TRANSPORT IN TURBULENT ASTROPHYSICAL PLASMAS. Newman, Charles Edward Jr. Stanford, Calif.; Stanford Univ. (1972). 79p. University Microfilms Order No. 72-20,719.

Thesis.

The effect of electromagnetic fluctuations, or plasma turbulence,

on the motion of the individual particles in a plasma is investigated; two alternative methods are used to find a general equation governing the time-evolution of a distribution of charged particles subject to both an external force field and the random fields of the fluctuations. It is found that, for the high-temperature, low-density plasmas frequently encountered in the study of astrophysics, the presence of even a small amount of turbulence can have a very important effect on the behavior of the plasma. Two problems in which turbulence plays an important role are treated in detail. First, the contribution to electrical and thermal conductivities by the turbulence is calculated; it is shown that for the solar wind at the orbit of Earth the turbulent effects dominate the effects of interparticle collisions in the determination of these transport coefficients. The implications of the transport coefficient calculation on models of the solar wind are discussed. Second, the problem of a distribution of relativistic electrons being stochastically accelerated by plasma turbulence in addition to emitting synchrotron radiation is discussed; this process has been proposed by other authors to be responsible for the observed electron energy spectra of synchrotron radio sources, but, based on arguments concerning the particle flux in phase space, this proposal is found to be very improbable. (Diss. Abstr. Int., B)

46295 DESIGN CONSIDERATIONS IN THE MEASUREMENT OF ELECTRON TEMPERATURE IN THE IONOSPHERE. Tyler, A. F. (Univ. of Birmingham, Eng.). Radio Electron. Eng.; 42: No. 7, 309-13(Jul 1972).

Measurements of electron temperature in the ionosphere using rocket and satellite-borne probes were made, using an experimental technique involving an extension of Langmuir-probe principles. The apparatus, in its latest form, was developed to provide a more compact and reliable system by exploiting the advantages of linear integrated circuits over the discrete component circuitry used previously. In considering the performance of the experiment, particular attention was paid to the stability problems associated with the closed-loop system employed. (auth)

46296 NATURE OF A SEMI-SECULAR CYCLE IN THE TROPOSPHERE. Loginov, V. F. Tr. Gl. Geofiz. Observ.; No. 245, 25-30(1969). (In Russian).

Data supporting the cosmic nature of a semi-secular cycle in certain characteristics of the troposphere are advanced (the circulation of the atmosphere in the region of the North Sea, a thermal cycle at high latitudes). Taking into account contemporary knowledge of the intensity and the structure of the magnetic field in the Universe, and the assumption of high-energy particles as a disturbing factor in tropospheric circulation, it is possible to comprehend many features of the Sun–troposphere relation in time, and in particular their instability. (tr-auth)

46297 CIRCULATION IN THE TROPOSPHERE AND THE STRATOSPHERE AND HIGH-ENERGY PARTICLES. Sazonov, B. I. Tr. Gl. Geofiz. Observ.; No. 245, 56-63(1969). (In Russian).

Atmospheric circulation on the Earth under various conditions is considered, particularly the cyclones and anticyclones in the stratosphere. At the same time, circulation peculiarities in the atmosphere were different in these layers, and were traced not only in latitudinal, but also in longitudinal effects at levels H_{30} and H_{500}. Reasons are advanced supporting the hypothesis of high-energy protons absorbed in the troposphere and stratosphere for being different at different levels, and accordingly stimulate the cyclone–anticyclone pairs at these levels. Troughs and crests are generated in tropospheric and in the stratosphere regions of attenuation of the intensity of the Earth's magnetic field, which are favorable to the intrusion of protons. These are related to the transfer of air masses from west to east in the region of a magnetic anomaly under the influence of cosmic radiation. (tr-auth)

46298 NEW METHOD FOR THE DETERMINATION OF N(h) IN THE D-REGION. Rumi, G.-C. (Istituto Elettrotecnico Nazional Galileo Ferraris, Turin). Nuovo Cim.; 10B: No. 1, 240-54(11 Jul 1972).

It is shown that an lf ((30 to 300) kHz) link operating essentially on a one-hop ionospheric propagation of an ordinary and quasi-transverse wave can be used for the determination of the electron density at some heights in the D region; it is just enough to detect certain peculiar doublets of single-strength breaks at the receiving site. Such breaks—fifteen of them were observed during February and March 1970 at the IENGF in Turin—are interpreted as the result of a swift increase of the electron density in the lower ionosphere and are shown theoretically to be characterized by the following values of the electron density N, and of the electron collision frequency ν: a) $N = 0.107\ f^2$ and b) $\nu = 13.60\ f$, where f is the operating frequency. Since $\nu = \nu(h)$ depends only on the height h, and is an available datum, a point of the electron-density profile, namely $N = 0.107\ f^2$ and $h = h(13.60\ f)$, can be associated with each break. The breaks yield information concerning a disturbed electron-density profile since they relate to disturbed conditions in the ionosphere. A method whereby the electron-density profile for quiet conditions can be derived from the same for disturbed conditions is outlined. (auth)

46299 PHOTODETACHMENT OF ELECTRONS FROM MAJOR NEGATIVE IONS IN THE LOWER D REGION. Thomas, L.; Gondhalekar, P. M.; Bowman, M. R. (Radio and Space Research Station, Slough, Eng.). Nature (London); 238: No. 5359, 89-90 (14 Jul 1972).

It is stated that the relatively high atmospheric pressures in the lower D region of the ionosphere, at heights below about 80 km, permit the formation of negative ions by the three-body attachment of electrons to molecules or atoms, and the photodetachment of electrons from negative ions by solar radiations has been used to explain increases in electron concentrations occurring prior to ground sunrise. A theoretical study of the height distributions of electrons and negative ions shows the need, however, to consider the detachment of electrons from the major negative ions throughout the day in order to account for the daytime electron concentrations observed below 70 km. Reliable laboratory measurements of photodetachment efficiencies are available only for O^-, O_2^- and O_3^-, but the likely effects of including the photodetachment of electrons from other ions, such as CO_3^-, NO_2^- and NO_3^- are here considered. (UK)

46300 THEORETICAL MODELS OF IONOSPHERIC STORMS. Matuura, Nobuo (Radio Research Labs., Tokyo). Space Sci. Rev.; 13: No. 1, 124-89(May 1972).

Ionospheric F-region disturbances, commonly called ionospheric storms, are characterized by changes in global electron-density distribution over a period of a few days accompanied by geomagnetic storms. The global morphology and disturbances in polar and high-latitude regions and equatorial regions are described. Processes affecting the ionosphere are discussed, including: corpuscular effects on the ionosphere, chemical reactions in the ionosphere, and effects of plasma transport. The theoretical models of ionospheric storms presented are for global disturbances in the upper atmosphere, polar and high-latitude ionosphere, middle- and lower-latitude ionosphere, and equatorial ionosphere. 350 references. (J.C.W.)

Particle Kinetics and Trapping

46301 (N-72-18362) LIGHT-ION TROUGH. Taylor, Harry A. Jr. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Feb 1972. 35p. (NASA-TM-X-65832; X-621-72-44). NTIS.

Several fundamental characteristics of LIT (light ion trough), including evidence of diurnal variation as well as response to magnetic disturbances, are identified. These identifications were made using the Bennett radio-frequency ion mass spectrometer onboard the OGO 6 from 1969 to 1970. It was shown that the LIT, rather than the total ionization trough, appears as a more meaningful indicator of the plasmapause. This makes the LIT a fundamental parameter for studies of the formation and maintenance of the plasmasphere. (STAR)

46302 ANALYSIS OF PIONEER 9 LOW-FREQUENCY WAVE OBSERVATIONS NEAR INTERPLANETARY DISCONTINUITIES. Scarf, F. L.; Greenstadt, E. W. (TRW Systems Group, Redondo Beach, Calif.). J. Geophys. Res.; 77: No. 19, 3317-27(1 Jul 1972).

The sector boundary of February 2, 1969 was unusually complex, and within a single 7-hour period the Pioneer 9 magnetometer and plasma probe detected a reverse shock, a slow shock, and a conventional fast shock. During this interval the electron gyrofrequency and the ion plasma frequency each varied by more than a factor of 10, and the low-frequency (broad-band and 400-Hz) electric-field wave levels were high and variable. It is shown that, near the discontinuities, enhanced 400-Hz wave levels were not generally associated with field gradients or current layers, but elevated 400-Hz wave levels were detected when the ion density fell within a fairly well-defined window. This suggests that modes related to ion sound waves were detected, and the observations are assessed in terms of various theories for interplanetary-wave generation. (auth)

46303 EXPLORER 33 AND 35 PLASMA OBSERVATIONS OF MAGNETOSHEATH FLOW. Howe, Herbert C. Jr.; Binsack, Joseph H. (Massachusetts Inst. of Tech., Cambridge). J. Geophys. Res.; 77: No. 19, 3334-44(1 Jul 1972).

The magnetosheath flow in the region $-60\ R_E \leq X_{SE} \leq -20\ R_E$ is mapped by using plasma data from the Massachusetts Institute of

Technology plasma experiments on the Earth-orbiting Explorer 33 and the lunar-orbiting Explorer 35. Temporal and spatial variations in the flow are separated by using 309 hours of simultaneous data from the two spacecraft, one spacecraft being in the solar wind and the other spacecraft in the magnetosheath. The overall flow pattern agrees well with the predictions of a simplified hydrodynamic theory. The measured ratio of magnetosheath to solar-wind densities is shown to have some dependence on the observed solar-wind sonic Mach number. This density ratio is consistently <1 in the region adjacent to the magnetotail boundary and thus reflects the irreversible nature of the flow across the bow shock. (auth)

46304 ENTRY OF HIGH-ENERGY SOLAR PROTONS INTO THE DISTANT GEOMAGNETIC TAIL. Durney, A. C. (European Space Tech. Centre, Noordwijk, Netherlands); Morfill, G. E.; Quenby, J. J. J. Geophys. Res.; 77: No. 19, 3345-60(1 Jul 1972).

During the solar proton events of November 18, 1968, and February 25, 1969, a detector on board the low-altitude polar-orbiting Esro-2 spacecraft observed marked structure in the enhanced intensities of 100- to 300-MeV protons at high latitudes. While concentrating mainly on the results of the northern hemisphere for November 18, this structure has been investigated in an attempt to discover the access mechanisms for these protons. A trajectory program was developed to discover the access positions at the magnetopause and the asymptotic directions: it was found that the main features of the structure could be accounted for by direct access of the anisotropic interplanetary flux and by a high-intensity flux of protons approaching the Earth from the tail. Secondary features of the structure need an improved trajectory program for interpretation. After a brief discussion of some tail models the conclusion was reached that the protons entering the tail were not consistent with either a diffusive or an adiabatic reconnection model. A tail access process that appears to satisfy the results and whose main requirements are a sharp magnetic-field boundary at the magnetopause and a slightly divergent tail field is discussed. (38 references) (auth)

46305 CHANGES IN MAGNETOSPHERIC CONFIGURATION DURING THE SUBSTORM GROWTH PHASE. Coroniti, F. V.; Kennel, C. F. (Univ. of California, Los Angeles). J. Geophys. Res.; 77: No. 19, 3361-70(1 Jul 1972).

Three calculations suggest that the magnetospheric configuration changes during the substorm growth phase. A flaring-tail model indicates that the observed increases in geomagnetic-tail field are explained if the dayside magnetopause shrinks by 1 to 2 R_E. Increased tail flaring also requires that the tail current sheet approach near the Earth during the growth phase. The motion of the inner edge of the plasma sheet, and consequently an equatorward shift of the nightside auroral oval, is consistent with the structural modifications mentioned above. (auth)

46306 ANISOTROPY OF HIGH-LATITUDE ELECTRON FLUXES DURING SUBSTORMS AND STRUCTURE OF THE MAGNETOTAIL. McDiarmid, I. B.; Hruska, A. (National Research Council of Canada, Ottawa). J. Geophys. Res.; 77: No. 19, 3377-83(1 Jul 1972).

High-latitude electron profiles (E > 20 keV) observed near midnight during the expansive phase of substorms frequently show pitch-angle distributions strongly peaked at 90° to the local magnetic field. Such distributions, which are characteristic of bouncing particles, are observed up to invariant latitudes of 80°, which is roughly 10° higher than normal. This phenomenon implies that the tail magnetic field up to distances of the order of 100 R_E is closed and sufficiently regular to allow electrons of these energies to bounce between mirror points. The results suggest that during the expansive phase of substorms the neutral line lies many tens of Earth radii beyond the Earth and that the thickness of the neutral sheet may be of the order of magnitude of the thickness of the plasma sheet. The high-latitude electron profiles also suggest the existence of large but continuous variations of density in the tail plasma sheet in the direction perpendicular to magnetic lines of force. (auth)

46307 HIGH-ENERGY ELECTRON SPIKES AT HIGH LATITUDES. Brown, J. W.; Stone, E. C. (California Inst. of Tech., Pasadena). J. Geophys. Res.; 77: No. 19, 3384-96(1 Jul 1972).

Over 750 spikes of precipitating electrons with $E \geq 425$ keV were observed aboard the low-altitude polar orbiter Ogo 4 between July 30, 1967, and December 31, 1967. The spikes may be divided into three distinct populations depending on whether they occur at latitudes below, at, or above the local limit of trapping. These spikes are designated type 1, 2, and 3, respectively. Type-3 spikes occur in a narrow latitude band about 3° wide, centered at invariant latitude $\Lambda \approx 78°$ at 1000 MLT (magnetic local time) and 68° at 2000 MLT. Their relative frequency of occurrence, intensity, and hardness do not depend significantly on magnetic local time. Type-3 spikes appear to be associated with spikes observed near the magnetopause and the neutral sheet. Type-2 spikes also occur in a latitude band about 3° wide, centered at about 71° at 1000 MLT and 67° at 2200 MLT. Their frequency of occurrence is highly dependent on magnetic local time, a large maximum occurring near 2300 and very few events occurring between 0600 and 1200 MLT. Type-2 spikes appear to be related to island fluxes in the neutral sheet, although they occur on closed field lines and may persist for many hours. Type-1 spikes occur in a wider band of latitudes, from about 62° to 68° near midnight and 66° to 68° near noon. The local-time dependence of their frequency of occurrence is similar to that of Type-2 spikes but less pronounced. Although they are observed on closed field lines, Type-1 spikes do not persist for periods longer than about 1 hour, and it was concluded that they are produced by strong pitch-angle scattering from the stably trapped population. The average spectral index (assuming a power-law spectrum) is 3 to 5, and the median flux (>425 keV) is about 150 el cm^{-2} sec^{-1} $ster^{-1}$, although Type-2 events near midnight tend to be larger and harder. All types tend to be more intense and to occur at lower latitudes when K_p is large. (auth)

46308 ELF NOISE BANDS ASSOCIATED WITH AURORAL-ELECTRON PRECIPITATION. Gurnett, D. A.; Frank, L. A. (Univ. of Iowa, Iowa City). J. Geophys. Res.; 77: No. 19, 3411-17(1 Jul 1972).

Observations of a new type of elf noise band that is closely associated with low-energy auroral electron precipitation are reported. These observations have been made at relatively low altitudes (<3000 km) with the polar-orbiting satellite Injun 5. The noise bands typically have a center frequency of 100 to 300 Hz and often appear to consist of many nearly monochromatic bursts, typically of a few seconds' duration, superimposed to produce the observed noise band. These elf noise bands are observed only in a relatively narrow range of latitudes (a few degrees) in the auroral zone and are almost always associated with intense fluxes, 10^9 el cm^{-2} sec^{-1} $ster^{-1}$, of precipitating electrons with energies from a few hundred electron volts to several kiloelectron volts. On the dayside of the magnetosphere the region where the elf noise bands and the associated low-energy electron precipitation are observed has been identified as the polar cusp. In considering the possible explanations of these elf noise bands it is noted that the spectral characteristics of this noise are very similar to a type of narrow-band electromagnetic noise called "lions roar," which has been observed at much higher altitudes in the magnetosheath with the satellite Ogo 5. It is suggested that the elf noise bands observed at low altitudes with Injun 5 are caused by lion's roar emissions that have propagated down "open" magnetic-field lines to low altitudes from the magnetosheath region. (41 references) (auth)

46309 GEOMAGNETICALLY TRAPPED ALPHA PARTICLES. I. OFF-EQUATOR PARTICLES IN THE OUTER ZONE. Blake, J. B.; Paulikas, G. A. (Aerospace Corp., Los Angeles). J. Geophys. Res.; 77: No. 19, 3431-40(1 Jul 1972).

The population of trapped alpha particles in five contiguous energy channels between 0.85 and 9.0 MeV was measured in the B and L intervals $2 \leq L \leq 4$ and $0.06 \leq B \leq 0.35$ gauss during June and July 1969. The particle distribution functions of these particles suggest that the location of the source of these particles is at $L > 4$ and that inward radial diffusion determines the spatial and energy distributions. The particle distribution functions show that these alpha particles do not diffuse into the inner zone. These results provide no support for the concepts of in-situ acceleration or direct capture of energetic solar alpha particles. (auth)

46310 INNER-ZONE ENERGETIC-ELECTRON REPOPULATION BY RADIAL DIFFUSION. Tomassian, Albert D. (Univ. of California, Los Angeles); Farley, Thomas A.; Vampola, Alfred L. J. Geophys. Res.; 77: No. 19, 3441-54(1 Jul 1972).

A quantitative study of the intrusion of natural electrons into the inner radiation zone during and after the geomagnetic storm of September 2, 1966, shows that the transport is consistent with a radial-diffusion mechanism in which the first two invariants are conserved. Except for the 3-day period of the storm main phase when data were missing, the radial-diffusion coefficient is $D = 2.7 \times 10^{-5} L^{7.3} \mu^{-0.5}$ day^{-1} in the range $1.7 \leq L \leq 2.6$ and $13.3 \leq \mu \leq 27.4$ MeV $gauss^{-1}$. This value could be produced by variation of a large-scale electric field across the magnetosphere having an amplitude of 0.28 mV/m and a period of 1600 sec. Electric fields having approximately these characteristics have been inferred from previous observations of the motion of whistler ducts within the plasmapause. If fields of this amplitude and period exist throughout the magnetosphere, the radial diffusion of all geomagnetically trapped particles except the high-energy inner-zone protons is strongly influenced by electric-field variations. A comprehensive review of previously reported radial-diffusion coef-

ficients shows reasonable agreement for L less than about 3.0, but serious discrepancies among reported values exist for determinations made in the outer zone. These discrepancies cannot be explained by the simple theory of radial diffusion due to variation of large-scale electric or magnetic fields. (auth)

46311 PITCH-ANGLE DIFFUSION OF RADIATION-BELT ELECTRONS WITHIN THE PLASMASPHERE. Lyons, Lawrence R.; Thorne, Richard Mansergh; Kennel, Charles F. (Univ. of California, Los Angeles). J. Geophys. Res.; 77: No. 19, 3455-74(1 Jul 1972).

An attempt is made to explain the formation of the quite-time electron slot, which divides the radiation-belt electrons into an inner and an outer zone. The pitch-angle diffusion of radiation-belt electrons resulting from resonant interactions with the observed plasmaspheric whistler-mode wave band is investigated. The effects of wave propagation obliquely to the geomagnetic-field direction with the resulting diffusion at all cyclotron-harmonic resonances and the Landau resonance are evaluated, along with the effects of interactions occurring at all geomagnetic latitudes. The results account for the long-term stability of the inner radiation zone, the location of its outer edge as a function of electron energy, and the removal of electrons to levels near zero throughout the slot. Computed pitch-angle distributions and precipitation decay rates are in good agreement with slot-region observations. (38 references) (auth)

46312 OBSERVATION OF VERY-LOW-FREQUENCY WHISTLER-MODE WAVES IN THE REGION OF THE RADIATION-BELT SLOT. Koons, H. C.; McPherson, D. A. (Aerospace Corp., El Segundo, Calif.). J. Geophys. Res.; 77: No. 19, 3475-82(1 Jul 1972).

Following a sudden-commencement magnetic storm, band-limited vlf emissions between 3.9 and 10.4 kHz were observed at high altitudes within the plasmasphere (L ~ 2.5 to 3.6) by a receiver aboard spacecraft OV1 14 (1968-26B). The maximum spectral intensities of 1.1 $m\gamma/Hz^{\frac{1}{2}}$ and 2.8 $\mu v/Hz^{\frac{1}{2}}$ on the magnetic and electric antennas, respectively, occur in the 5.6-kHz channel. The waves can resonantly interact with energetic electrons above ~50 keV at L = 2.5, and the measured wave intensities are sufficiently high to account for the short lifetimes of medium-energy electrons in the slot region between the inner and outer Van Allen radiation zones. A comparison with ground-based vlf data suggests that the waves are generated by band-limited amplification of incoherent noise. (auth)

46313 TURBULENCE OF ELECTROSTATIC ELECTRON CYCLOTRON HARMONIC WAVES OBSERVED BY OGO 5. Oya, Hiroshi (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res.; 77: No. 19, 3483-94(1 Jul 1972).

Vlf emissions that have been observed near $3/2\ f_H$, $5/2\ f_H$, and $7/2\ f_H$ by Ogo 5 in the magnetosphere (f_H is the electron cyclotron frequency) are analyzed in the light of the mechanism used for the diffuse plasma resonance f_{Dn} observed by Alouette 2 and Isis 1. The vlf emission is considered to be generated by nonlinear coupling mechanisms in certain portions of the observation as the f_{Dn} is enhanced by its association with nonlinear wave-particle interaction of the electrostatic electron cyclotron harmonic wave, including the instability due to the nonlinear inverse Landau damping mechanism in the turbulence. The difference between the two observations is in the excitation mechanism of the turbulence; the turbulence in the plasma trough detected by Ogo 5 is due to natural origins, whereas the ionospheric topside sounder makes the plasma-wave turbulence artificially by submitting strong stimulation pulses. Electron density values in the plasma trough are deduced by applying the $f_{Dn}-f_N/f_H$ relationship obtained from the Alouette-2 experiment as well as by applying the condition for the wave–particle nonlinear interactions. The electron density values reveal good agreement with the ion-density values observed simultaneously by the highly sensitive ion mass spectrometer. (auth)

46314 STABILITY OF OBLIQUELY PROPAGATING WHISTLERS. Brinca, A. L. (Stanford Univ., Calif.). J. Geophys. Res.; 77: No. 19, 3495-3507(1 Jul 1972).

By means of an energy conservation approach, an analysis was made of the growth rates of whistlers with arbitrary frequency and direction of propagation in a cold plasma permeated by a dilute energetic electron population. Numerical results are obtained for whistler frequencies and plasma characteristics prevailing at the onset of artificially stimulated emissions ($\omega/\Omega \sim 0.5$, $\omega_p/\Omega \sim 10$, the energetic electron population with varying energy and pitch angle). It is found that the growth rates do not, in general, maximize for propagation along the static magnetic field, and a criterion for the existence of maximal growth at this direction is derived. An application to artificially stimulated emissions is discussed. (auth)

46315 WHISTLER SIDE-BAND GROWTH DUE TO NON-LINEAR WAVE–PARTICLE INTERACTION. Brinca, A. L. (Stanford Univ., Calif.). J. Geophys. Res.; 77: No. 19, 3508-23 (1 Jul 1972).

The distortion caused by a large-amplitude whistler (with wave normal parallel to the static magnetic field) on the energetic-electron velocity distribution of a predominantly cold magnetoplasma is derived analytically. Whistler test waves impressed on the perturbed magnetoplasma and within two narrow bands centered on the frequency ω_0 of the original wave may experience large consecutive growth at the early stages of the wave-particle interaction if the unperturbed energetic-electron distribution $f_0(\nu_{||}, \nu_\perp)$ satisfies two conditions. First f_0 must have a certain degree of $\nu_\perp$ monochromaticity (a well-defined peak for some $\nu_\perp > 0$); second, f_0 either must be linearly unstable for the original whistler or, if it is stable, it must satisfy $2(\Omega/k_0)\int_0 f_0\nu_\perp d\nu_\perp \approx |\int_0^\infty \nu_\perp{}^3(\partial f_0/\partial\nu_{||})d\nu_\perp|$ where the integrals are evaluated at $\nu_{||} = (\omega_0 - \Omega)/k_0$, Ω is the electron cyclotron frequency of the static magmagnetic field, and k_0 is the wave number of the original whistler. The relevance of these whistler side bands to magnetospheric phenomena is assessed; in particular, an identification of the onset of artificially stimulated emissions with the creation of whistler side bands gives good agreement with observations. (36 references) (auth)

46316 12-MONTH WAVE IN GEOMAGNETIC ACTIVITY. Meyer, Joachim (Freie Univ., Berlin). J. Geophys. Res.; 77: No. 19, 3566-74(1 Jul 1972).

Besides the well-known 6-month wave in geomagnetic activity and its recurrence tendency, no persistent 12-month wave has been detected by harmonic analysis of consecutive monthly values. Such a 12-month wave, however, can be shown to exist if, instead, single activity sequences are analyzed, i.e., daily values at intervals of one solar rotation. A harmonic sequence analysis of this kind has been carried out for the daily character figures C8 from 1884 to 1968. For years before and including sunspot minimums two clearly distinguished significant 12-month waves having nearly equal amplitudes and opposite phases are obtained. The maximum occurs shortly after one of the two equinoxes: at the end of March or at the beginning of October. The amplitude is almost 3 times that of the semiannual wave in the same sequences. For years around sunspot maximums the amplitude is smaller, and in the harmonic dial the clouds of points for both 12-month waves can no longer be clearly distinguished. The dates of maximum of the revealed 12-month wave again exclude an explanation by means of the classical axial hypothesis. The statistical result instead suggests an interpretation primarily by means of a temporary N–S symmetry in the distribution of the magnetic M regions within single solar sectors and the same magnetospherical modulation mechanism responsible for the 6-month wave. (auth)

46317 DAYTIME IRREGULAR GEOMAGNETIC PULSATION, Pid, AND ITS RELATION TO MAGNETOSPHERIC SUBSTORM. Morioka, Akira; Saito, Takao (Tohoku Univ., Sendai). Rep. Ionosphere Space Res. Jap.; 25: No. 4, 343-59(Dec 1971).

The daytime irregular pulsation in the auroral zone, Pid, is studied from data obtained with induction magnetometer at Syowa Station in 1968. Results of the analysis show that (1) the waveform of Pid is expressed by a group of many impulses having approximate pulse-height with a fraction of gammas, pulsewidth between one and five seconds, a repetition period between five and twenty seconds; (2) Pid occurs most frequently in the daytime and tends distinctly to occur on magnetically disturbed days; (3) Pid is frequently associated with the daytime cosmic-noise absorption; (4) Pid appears in the day-side auroral zone with a systematic time lag behind the breakup of a magnetic substorm on the night side; and (5) the time lag of the onset time of Pid behind that of the substorm is proportional to the local time of the onset of Pid. A model of the generation mechanism of Pid is proposed: a part of the energized electrons produced during the onset of the magnetospheric substorm drifts eastwards around the Earth, and is precipitated into the day-side auroral zone, causing the daytime cosmic-noise absorption and x-ray microbursts; the high-energy electron microbursts contribute to the ionospheric E layer, giving rise to a series of temporal and localized enhancements of the ionospheric current, whose magnetic effect is observed as a group of the impulses when the observation is carried out with induction magnetometers on the ground. (auth)

46318 CHERENKOV INSTABILITY AND VLF EMISSIONS GENERATED OUTSIDE THE PLASMAPAUSE. Kimura, Iwane (Kyoto Univ.). Rep. Ionosphere Space Res. Jap.; 25: No. 4, 360-8(Dec 1971).

A coupling between electromagnetic waves and space-charge waves due to beaming electrons in an ambient plasma is reconsidered. Strong couplings take place in the close vicinity of the ambient plasma frequency and electron cyclotron frequency. A

whistler-mode wave can be amplified by such a coupling for frequencies a little less than the plasma frequency if the plasma frequency is less than the cyclotron frequency. This condition will probably occur just outside the plasmapause. Vlf emissions generated by such a mechanism should be closely associated with the location of the plasmapause. (auth)

46319 ASSOCIATION BETWEEN QUASI-PERIODIC VLF EMISSION AND MICROPULSATION. Kokubun, Susumu (Tokyo Univ.). Rep. Ionosphere Space Res. Jap.; 25: No. 4, 383-8(Dec 1971).

Vlf emissions with periods from 2 to 260 s, called periodic emission and quasi-periodic emission (QP) or long-period vlf pulsation, are often observed at high and middle latitudes. QP emissions with periods longer than 6 s are considered to be the result of hydromagnetic modulation of the basic emission source in the magnetosphere. The associations between micropulsations and vlf emissions show experimental evidence for the hydromagnetic modulations of vlf emissions based on data at Syowa Station. Four examples of intensity-modulated emissions accompanying worldwide geomagnetic changes are shown and discussed. These include a quasi-periodic modulation of vlf emission intensity associated with a world-wide geomagnetic change; periodic vlf emission associated with a regular micropulsation with a period of 10.8 seconds; concurrent occurrence of quasi-periodic emission and quasi-sinusoidal micropulsations with a period of about 40 seconds; and an association between vlf chorus emissions and irregular micropulsations. (J.C.W.)

46320 IDENTIFICATION OF SOLAR-NEUTRON EVENTS BY OBSERVATION OF RADIATION-BELT PROTON FLUXES. Claflin III, Edward Scott. Riverside, Calif.; Univ. of California (1971). 186p. University Microfilms Order No. 72-17,053. Thesis.

A region of theoretically stable trapping but experimentally low flux exists at the outer edge of the trapped proton belt. Trapping lifetimes in this region are shorter than the 10 to 200 years typical of the inner belt. Trapping for periods exceeding ½ hour may occur. A burst of neutrons arriving at the Earth following a solar flare will cause an increase in the trapped proton flux above 20 MeV. Quantitative prediction of the increase is made possible by calculation of the injection coefficient for solar neutrons. For a sufficiently intense neutron burst, an increase will be detectable in the low flux at the outer edge of the proton belt. Proton spatial and pitch-angle distributions will help to identify the solar neutron source. Lower limits on the required neutron flux are estimated and compared with upper limits established by experiment. It is found that observation of trapped-neutron-decay protons is potentially a factor of 10 more sensitive for detecting solar neutrons than past satellite neutron experiments. A possible example of detection of trapped-neutron decay protons occurred following the August 28, 1966 solar flare. An unusual count-rate increase was observed immediately after the flare by the UCSD detector aboard Explorer 26. Comparison with Vela neutron detector data shows that the increase could not have been caused by trapped neutron decay protons. Additional events of this kind have not been found. More sensitive proton detectors may be able to observe the predicted effect. (Diss. Abstr. Int., B)

46321 MAGNETOHYDRODYNAMIC EFFECTS AT THE MAGNETOSPHERE BOUNDARY. Verzariu, Pompiliu. Washington, D. C.; American Univ. (1971). 94p. University Microfilms Order No. 72-18,100. Thesis.

Interactions between the solar wind and the magnetosphere are discussed relative to the following two aspects: (a) variations in the compression of the magnetosphere responding to solar-wind pressure changes; and (b) reflection and refraction of magnetohydrodynamic (MHD) waves at the boundary of the magnetosphere. Concerning (a), it is found that solar-wind pressure changes and magnetic-field changes at the Earth's surface are linearly correlated during magnetically quiet conditions in accordance with the theoretical expectations from the pressure balance between the solar-wind plasma and the Earth's magnetic field. A constant of proportionality relating the two quantities is statistically determined. The average value for the proportionality constant agrees favorably with the theoretical value given by the Mead–Beard magnetosphere model. Magnetohydrodynamic (MHD) theory is used to study problem (b) above, namely the transmission of waves from the magnetosheath plasma into the magnetosphere under normal conditions of solar-wind flow. Two cases taken as representative of magnetopause conditions in the vicinity of the subsolar point and near the dusk and/or dawn meridian are considered. It is found that the total transmitted energy constitutes only about 1 to 2% of the energy flux for a distribution of isotropic incident waves. The flux transmitted into the magnetosphere from waves having an amplitude of 1 gamma (1 gamma = 10^{-5} gauss) is roughly of the order 10^{-6} to 10^{-5} erg cm^{-2} sec^{-1}. Assuming a steady isotropic flux of waves with amplitudes of 1 gamma incident on a hemispherical sunward magnetospheric boundary of radius 15 R_E, the total energy input into the magnetosphere is estimated to be of the order of 10^{21} erg per day. The wavelengths and amplitudes of the ripples induced by the MHD waves on the boundary surface are also examined. For the observed power density of MHD waves in the magnetosheath, the calculated wavelengths range from a few tenths of 1 R_E to several hundred Earth radii. (Diss. Abstr. Int., B)

46322 DISTURBANCE OF THE EARTH'S MAGNETIC FIELD AND ITS VARIATIONS IN THE ELEVEN-YEAR CYCLE. Ol, A. I. Tr. Gl. Geofiz. Observ.; No. 245, 35-48(1969). (In Russian).

The more important indices of magnetic disturbances and their variations in the 11-year cycle of solar activity are discussed in detail. Different indices reflect different types of corpuscular radiation from the Sun, the two basic types being flare and recurrent. Flare types arise during the maximum solar activity of the 11-year cycle, and recurrent types occur at the minimum. Annual variations in corpuscular radiation are also considered. Values of the index M of the magnetic disturbance are traced over the years from 1884 to 1967. (tr-auth)

46323 CONJUGATE POINT PHENOMENA. Rothmuller, I. J.; Beer, T. Sci. Progr. (Oxford); 60: No. 238, 205-15(Summer 1972).

A review is given of the magnetospheric and ionospheric manifestations of conjugate point phenomena. The model generally chosen in order to calculate conjugate points is discussed. The conjugate phenomena, visual aurora, x-ray aurora, whistlers, other vlf emission, micropulsations, magnetic variations and F-region effects are discussed. (UK)

Solar Wind and Cosmic Ray Interactions

Refer also to abstract: 46322.

46324 (N–72-18796) INTERACTION OF THE SOLAR WIND WITH A PLANETARY IONOSPHERE. Blank, J. L.; Sill, W. R. (Bellcomm, Inc., Washington, D. C.). 25 Jan 1972. Contract NASw-417. 37p. (NASA-CR–125673; TM–72-2015-1). NTIS.

An electrodynamic model for an ionosphere–solar wind interaction is developed based on the existence of a low-beta plasma below the anemopause. The currents for the interaction are driven by the solar-wind motional electric field and induce a stagnation magnetic field at the anemopause. For Venus and Mars, the lower region of the ionosphere near the electron density peak has the highest conductivity and, therefore, the tangential component of the induction current flows substantially in this region. The current paths close in the anemopause, which is a solar wind current sheath analogous to the magnetopause. Both the fraction of the undisturbed solar-wind motional electric field, which drives the induction current, and the required fraction of incident solar-wind particles, crossing the anemopause to produce this current, are shown to be small. (auth) (STAR)

46325 COSMIC-RAY ELECTRON SPECTRUM AND ITS MODULATION NEAR SOLAR MAXIMUM. Schmidt, P. J. (Univ. of Chicago). J. Geophys. Res.; 77: No. 19, 3295-3310 (1 Jul 1972).

A balloon-borne ionization spectrometer was used to measure the energy spectrum of cosmic-ray electrons in the range 20 MeV to 15 GeV. Balloon flights were made from Fort Churchill, Manitoba, Canada, in the summers of 1968, 1969, and 1970. Primary electron spectra were obtained for these three periods that show the effect of differing levels of solar modulation. In particular, a relatively strong decrease in the electron intensity between 300 MeV and 2 GeV was observed between 1969 and 1970, whereas neutron-monitor counting rates increased. It is shown that the data can be explained quantitatively by using the force-field approximation to the cosmic-ray transport equation if the rigidity dependence of the diffusion coefficient is generalized to be time-dependent. The parameters obtained in fitting the electron measurements, when they are applied to the 1968 proton energy spectrum, lead to general agreement with measurements under the assumption that the unmodulated proton spectrum is a power law in total energy. (43 references) (auth)

46326 HEAT CONDUCTION IN A TURBULENT MAGNETIC FIELD WITH APPLICATION TO SOLAR-WIND ELECTRONS.

Hollweg, Joseph V.; Jokipii, J. R. (California Inst. of Tech., Pasadena). J. Geophys. Res.; 77: No. 19, 3311-16(1 Jul 1972).

Random, long-wavelength fluctuations were considered in a turbulent magnetic field that can appreciably decrease the heat conductivity of a plasma along the magnetic field. In simple cases of interest, the reduction along the average field is approximately by the factor $\langle\cos\delta\theta\rangle^2$, where $\delta\theta$ is the angle of the local magnetic field relative to the average field. Application to solar-wind electrons indicates that this reduction in heat conductivity due to observed fluctuations in the interplanetary magnetic field may be of the order of a factor of 2. This may help to explain recent measurements that indicate a rather low electron heat flux in the solar wind. (auth)

46327 RIGIDITY DEPENDENCE OF COSMIC-RAY MODULATION AT RIGIDITIES >2 GV IN AUGUST 1969. Stoker, P. H.; Raubenheimer, B. C.; van der Walt, A. J. (Univ. for C.H.E., Potchefstroom, S. Afr.). J. Geophys. Res.; 77: No. 19, 3575-82 (1 Jul 1972).

The modulation function $M = \ln (dN_0/dP)/(dN/dP)$ is determined relative to solar minimum (May 1965) from differential responses obtained from survey flights at 307 g/cm^2 in October 1964, August 1966, and August 1969. The results for 1964 and 1966 are compatible with a modulation function proportional to P^{-1}, but for August 1969 the modulation is a much stronger function of rigidity, being either $M = \Delta\eta/P^{1.4}$ or $M = \Delta\eta/P + 4.0/P^2$. However, the counting rates of ground-based neutron monitors at high, middle, and low latitudes relative to solar minimum, are better represented by the latter modulation function for the time after the June 1969 reduction in cosmic-ray intensity, the modulation term $\propto P^{-1}$ being solar-controlled as for the 11-year variation and the term $\propto P^{-2}$ being of a more persistent nature. (auth)

46328 VELOCITY AND FLUX DEPENDENCE OF THE SOLAR-WIND HELIUM ABUNDANCE. Hirshberg, J. (Ames Research Center, Moffett Field, Calif.); Asbridge, J. R.; Robbins, D. E. J. Geophys. Res.; 77: No. 19, 3583-8(1 Jul 1972).

The causes of the variations in the relative abundance of helium in the solar wind are not understood. To define the theoretical problem more precisely, empirical relationships between helium abundances and other pertinent solar-wind parameters are necessary. It is shown that the average percentage of helium increases with the solar wind velocity. The straight-line least-squares fit to the data is given by $n_\alpha/n_p \times 10^2 = 1.02 \times 10^{-2}$ v $- 0.39$, where $n_\alpha/n_p \times 10^2$ is the mean percentage of helium averaged over a 25-km/sec data interval and v is the velocity of the center point of the interval in kilometers per second. It is confirmed that the abundance of helium tends to be higher for low solar-wind fluxes rather than lower as expected from theory. The interpretation of these results is discussed, and it is concluded that more realistic theoretical treatments of the problem are necessary before these results can be understood in terms of models of the solar corona and solar wind. (auth)

46329 DETECTION OF SOLAR-WIND ELECTRON PLASMA FREQUENCY FLUCTUATIONS IN AN OBLIQUE NONLINEAR MAGNETOHYDRODYNAMIC WAVE. Fredricks, R. W. (TRW Systems Group, Redondo Beach, Calif.); Scarf, F. L.; Russell, C. T.; Neugebauer, M. J. Geophys. Res.; 77: No. 19, 3598-3601(1 Jul 1972).

A nonlinear plasma-wave phenomenon was observed in the upstream interplanetary medium by Ogo 5 instrumentation on Jan. 30, 1969. Data are shown of the total ion flux, plasma-wave frequency, and total magnetic field. Source mechanisms for hf waves in the solar wind are discussed and show that changes in the wave growth conditions cannot readily account for significant frequency variations. The observed flux variations are related to changes in local density rather than to any large fluctuations in wind flow speed or direction. It is argued that the Doppler effect is always small for these wave modes and that this phenomenon cannot account for the wave frequency changes. It is concluded that the identification of the electron-plasma frequency emission whenever it is present in the solar wind provides a high-time-resolution measurement of local electron density. The technique represents an improvement over conventional probe techniques, which typically scan over energy on time scales of several seconds or longer. The availability of such quasi-instantaneous density measurements on common time scales with field measurements has a great potential impact on detailed theoretical interpretations. One such theoretical interpretation facilitated by the common time scale of density and magnetic field is exemplified by consideration of the large- amplitude oblique MHD wave and its associated large-amplitude density fluctuation. (J.C.W.)

46330 COMPARISON OF MEASUREMENTS OF THE CHARGE SPECTRUM OF SOLAR COSMIC RAYS FROM NUCLEAR EMULSIONS AND THE EXPLORER 35 SOLID-STATE DETECTOR. Armstrong, T. P. (Univ. of Kansas, Lawrence); Krimigis, S. M.; Reames, D. V.; Fichtel, C. E. J. Geophys. Res.; 77: No. 19, 3607-12(1 Jul 1972).

Recent measurements relating to the He/M (medium) nuclei abundance ratio in solar cosmic rays from solid-state detectors carried aboard the lunar orbiting Explorer 35 are compared with earlier measurements using nuclear emulsions. The He/M ratio of 27 ± 9 obtained from Explorer 35 in the energy range of 0.5-~2.5-MeV/nucleon for solar events in 1967–1968 is lower than the value 58 ± 5 measured earlier for large events in the 1960–1969 period in the 12- to 200-MeV/nucleon range with emulsions. A mild energy dependence of the abundance ratio is one possible explanation of the observed differences. (auth)

46331 PROBLEMS IN SOLAR-SYSTEM PLASMA PHYSICS. Leer, Egil. San Diego, Calif.; Univ. of California (1972). 125p. University Microfilms Order No. 72-17,444.

Thesis.

The excitation of parametric instabilities by radio waves in a magnetoplasma is discussed. A uniform medium is assumed and linear approximations are used. A simple method, based on energy balance, is used first to re-derive the well-known threshold condition for the purely growing parametric instability in a homogeneous medium and later to estimate the effects of inhomogeneity in a semiquantitative manner. The threshold is then calculated in a more quantitative manner for the case where the effects of inhomogeneity dominate over those of collisions. The method has the advantages that its range of validity is easily checked, that it provides good physical insight and that it is easily applicable to electromagnetic instabilities. The flow of plasma from the Sun is discussed. A two-fluid model of the solar wind with anisotropic proton temperature and allowing for extended coronal proton heating is considered for the case of a purely radial and of a spiral magnetic field. Proton–proton Coulomb collisions together with a spiral interplanetary magnetic field are found to be sufficient to reduce the thermal anisotropy in the proton gas to a value in agreement with observations. Reasonable values are obtained for the flow velocity, number density and the proton temperature near the orbit of the Earth. Kinetic and hydrodynamic descriptions of a collisionless solar wind proton gas are compared. Heat conduction and viscosity are neglected in the hydrodynamic formulation but automatically included in the kinetic formulation. The results of the two models are very nearly the same, indicating that heat conduction and viscosity are not important in the solar wind proton gas beyond about 0.1 AU. It is concluded that the hydrodynamic equations provide a valid description of the collisionless solar-wind protons, and hence that future models of the quiet solar wind should be based on a hydrodynamic formulation. (TSS) (Diss. Abstr. Int., B)

46332 STATISTICAL TREATMENT OF THE RELATIONSHIP BETWEEN THE SOLAR FLARE-PRODUCING REGIONS AND THE SC +SI EVENTS. Moldovanu, A.; Bradu, E. B.; Tarnauceanu, D. (Centre of Technical and Physical Research, Iasi). Gerlands Beitr. Geophys.; 81: No. 1-2, 1-7(1972).

The validity of the hypothesis that both geomagnetic storms and Forbush decreases can be ascribed to the effects of interplanetary streams produced in the solar wind by solar-flare producing regions and not to the effects of individual solar flares (Ballif and Jones) was examined statistically. For this purpose, an adequate graphical representation is used for each solar rotation for the individual solar flares and the flare-producing regions. The dynamics of the flare-producing regions is more evident. The SC and SI events appear to be grouped morphologically as collective events, gr(SC + SI), supposing that each gr(SC + SI) event reflects the interaction between a tangential discontinuity and the magnetosphere. The main hypothesis assumes that if the tangential discontinuities are really related to the flare-producing regions, then for successive rotations, the variation of the number of flare-producing regions passing the solar central meridian must be followed by a parallel variation in the number of gr(SC + SI) events. The data obtained from the analysis of 19 solar rotations around the maximum of the solar cycle No. 20 (rotations 1839–1857) reveal a good correlation between the variation of the number of flare-producing regions, active at the central meridian, and the variation in the number of gr(SC + SI) events ($r \sim 0.9$). On such a statistical treatment, the working hypotheses are better proved than in the one-to-one treatment. Hence, the main cause of the geomagnetic disturbances, as the SC and/or SI events, appear to be the interplanetary streams or the tangential discontinuities, somehow related to the flare-producing regions. (auth)

46333 SOME STUDIES ON SOLAR MICROWAVE BURSTS OF DIFFERENT TYPES IN RELATION TO OPTICAL FLARES AND

OTHER ALLIED EVENTS. Das Gupta, M. K. (Univ. of Calcutta); Sarkar, S. K. Indian J. Pure Appl. Phys.; 10: No. 2, 153-60(Feb 1972).

Occurrences of some common types of solar microwave bursts at 4995 and 8800 MHz were studied in relation to flares of different areas and intensities were examined for the period November 1966 to September 1969. It has been found that simple impulsive bursts have the maximum occurrences, and complex bursts show the maximum percentage association with solar flares. Further, both complex bursts and complex bursts with fluctuations show maximum association with bright flares while all other remaining types are in general associated with flares of normal intensity. Moreover, the variation of their percentage association with increase of both peak fluxes and energies of the bursts has also been examined. It has been noted that, except for post-burst increase, for all other types of bursts, percentage association values increase with increasing peak fluxes and energies. Complex bursts show relatively higher percentage associations in all the ranges. Of the different types of bursts, solar microwave great bursts are of vital importance for their close connection with different events. These great bursts during the period November 1966 to January 1970 have also been examined in relation to solar flares, solar meter-wave bursts, different types of sudden ionospheric disturbances, and geomagnetic crochets. Distribution of the sources of great bursts over the solar disk shows a strong north–south asymmetry. Great bursts are highly associated with meter-wave type-III (fast drift) bursts. Great bursts show maximum association with bright flares. In general, these are highly associated with SIDs. Association with SPA is 100% and with SWF 97.9%. Association with crochets increases with the peak flux of the great bursts, the burst-associated crochets being mainly due to bright flares. Variation of the peak flux of great bursts with frequency has also been examined. (auth)

46334 SCIENTIFIC RESULTS FROM HEOS 1. Taylor, Brian G. (European Space Research and Tech. Centre, Noordwijk, Netherlands). Raumfahrtforschung; 16: No. 3, 101-7(1972).

Selected major results of the eight scientific experiments carried aboard the HEOS-1 spacecraft were presented. This ESRO satellite was launched on December 5, 1968, into a highly eccentric orbit. Significant and unique results have been obtained during the following three years. The discussion of measurements especially regarding interplanetary shock and solar-wind interactions is complemented by an extensive list of literature comprising all papers about the scientific results published so far. (auth)

PHYSICS (ATOMIC AND MOLECULAR)

Atomic, Electron, Ion, and Molecular Beams and Their Reactions

Refer also to abstract: 47245.

46335 (FRNC-TH-198) CAPTURE OF LOW-ENERGY RARE GAS IONS BY METALLIC TARGETS. Roussel, Joseph (Paris Univ., Orsay (France)). 1971. 100p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

Experimental results on the capture of the rare gases Ar and Ne by the surface of a monocrystalline Mo target bombarded with ions in a direction normal to the 110 plane are presented. Theoretical studies were also made. They consisted of determining the interaction potential between the atoms and of developing a capture model for the calculation of the capture coefficients. It is shown that a rare gas atom is captured, essentially, by a substitutional mechanism involving the ejection of the metal atom, the substituted atom being retained by the lattice if it is sufficiently surrounded. The spheres used to calculate the transparence of the atomic layers traversed (in the framework of a hard sphere approximation) correspond to the energy-loss cross sections; in particular the atom taking part in a collision too near to the head-on case does not have enough energy left to create for itself a capture site. (auth)

46336 SURFACE AND VACUUM PHYSICS INDEX. VOLUME 7, NO. 5, 1972. Bibliography, Author Index, Subject Index in Alphabetical Order, Cumulative Subject Index in Logical Order. Frankfurt am Main; Zentralstelle fuer Atomkernenergie-Dokumentation (1972). 74p.

This listing contains 256 references on various aspects of the subject. (M.O.W.)

46337 STUDY OF RELATIVE LEVEL POPULATIONS IN FOIL EXCITED He AND Li. Andersen, N.; Carriveau, G. W.; Glinska, A. F.; Jensen, K.; Melskens, J.; Veje, E. (Univ. of Copenhagen). Z. Phys.; 253: No. 1, 53-60(1972).

A set of relative level population measurements was made for 40-keV beam–foil-excited He and Li. The relative populations are discussed as functions of the principal quantum number, the azimuthal quantum number, the spin, and the excitation energy. (auth)

46338 OPTIMIZATION OF LOW-ENERGY ELECTRON SCATTERING FOR PRODUCING A BEAM OF SPIN-POLARIZED ELECTRONS. Zeman, Herbert David. Stanford, Calif.; Stanford Univ. (1972). 99p. University Microfilms Order No. 72-16,821.

Thesis.

The means by which the highest possible output polarized electron beam quality may be achieved using low-energy electron scattering from gases are discussed. A particular source of polarized electron beams utilizing low-energy scattering of an electron beam produced by a thermionic arc electron gun from mercury atoms in an atomic beam is described. Measurements were taken with a primary beam energy of 50 eV at a scattering angle of 60° and with a primary beam energy of 170 eV at a scattering angle of 50°. Graphs of output polarization and intensity are given vs primary beam current for a variety of mercury atomic beam densities at both operating points. The best beam achieved had a current of 40 nA and a polarization of 20%. (Diss. Abstr. Int., B)

46339 ENERGY SHIFTS AND RELATIVE INTENSITIES OF K X RAYS PRODUCED BY SWIFT HEAVY IONS. Saltmarsh, M. J.; van der Woude, A.; Ludeman, C. A. (Oak Ridge National Lab., Tenn.). Phys. Rev. Lett.; 29: No. 6, 329-33(7 Aug 1972).

The energy shifts of Fe, Co, Zr, and Sn K x rays produced by 5-MeV/amu He, C, O, Ne and 10-MeV/amu C ions depend nearly linearly on the stopping power for the bombarding ion. The shifts and the $K\beta/K\alpha$ ratios show a projectile energy dependence similar to that predicted for the L-ionization cross section. This suggests that these phenomena can be explained by existing Coulomb excitation theories. (auth)

Atomic and Molecular Properties

Refer also to abstracts: 46413, 46415, 46417, and 46523.

46340 (ORNL-TM-3820) PHOTOELECTRON CHEMICAL SHIFTS IN INORGANIC COMPOUNDS. McGuire, Gary Elder (Oak Ridge National Lab., Tenn.). Jul 1972. Contract W-7405-eng-26. 103p. Dep. NTIS.

Thesis. Submitted to Tennessee Univ., Knoxville.

Selected inner-shell ionization energies of a variety of inorganic compounds were examined by using x-ray photoelectron spectroscopy. Attempts were made to relate the chemical shifts in the core level energies to structural and bonding properties of the compounds. Among the materials studied were UO_2, UO_3, and U_3O_8. It was found that it was possible to distinguish the three oxides by photoelectron spectroscopy because the uranium core electrons have slightly different binding energies in each compound. It was also observed that the chemical shift from uranium metals to the uranium oxides was smaller than the shift observed in going from the metal to the metal oxide in the case of other metals. (A.G.W.)

46341 (UCRL-51231) THEORETICAL RADIATIVE TRANSITION RATES FOR K- AND L-SHELL X RAYS. Scofield, James H. (California Univ., Livermore. Lawrence Livermore Lab.). 1 Jun 1972. Contract W-7405-eng-48. 62p. Dep. NTIS.

Theoretical results covering the range of elements from Z = 5 to 102 are given for the radiative transition rates in filling vacancies in the K and L shells. The calculations use a relativistic Hartree model for the atoms. Given here are the ratios of the rates for the major K-shell x rays, the total radiative decay rate and theoretical binding energies for the K shell and L subshells, the transition rate and theoretical energy for each K x ray going by E-1, E-2, or M-1 radiation and each L x ray going by E-1 or E-2 radiation, the ratios of M-2 to E-1 rates, and the A_{22} angular correlation factor between K and L x rays. (auth)

46342 ELECTRIC FIELD EXPERIMENTS ON THE METASTABLE STATES OF HELIUM. Petrasso, Richard David. Waltham, Mass.; Brandeis Univ. (1972). 57p. University Microfilms Order No. 72-17,995

Thesis.

The atomic-beam magnetic-resonance technique was used to measure the relative Stark splitting between the M = ± 1 and the M = 0 Zeeman sublevels of the 2^3S_1 state of helium. This shift should be zero in the LS coupling approximation. The shift is $(1.14 \pm 0.04) \times 10^{-1}$ Hz/(statV/cm)^2 and can equivalently be interpreted as giving rise to a tensor polarizability of $(3.41 \pm 0.11) \times 10^{-3}$ a_0^3. The shift decreases the normal magnetic splitting between the M = +1 and the M = 0 sublevels. Measurement of the transition rate of the normally metastable helium 2^1S_0 state in the presence of a uniform electric field by observing the attenuation of a metastable beam of helium passing between parallel electric field plates is also reported. This attenuation, when combined with measurement of the velocity distribution of the beam, yields a transition rate of (0.926 ± 0.020) F^2 s^{-1} where F is the field strength in kilovolts per cm. This agrees well with the calculated value of (0.920 ± 0.030) F^2 s^{-1} which is derived from a sum of oscillator strengths published by various workers. Both the experimental and theoretical values are in clear disagreement with the Bethe–Lamb theory, which predicts a transition rate of greater than 1.17 F^2 s^{-1} for the helium 2^1S_0 state. The Bethe–Lamb equations have been used extensively to calculate the electric-field quenching of hydrogen and hydrogen-like atoms in the $2^2S_{1/2}$ state. Applying the quench theory used for the helium calculation to the hydrogen $2^2S_{1/2}$ gives the same transition rate as the Bethe–Lamb theory to within 1%. The previous experimental checks of the Bethe–Lamb theory were made only on hydrogen and hydrogen-like atoms; the results of these experiments indicated that this theory was valid. However, the helium quench experiment shows unambiguously that the Bethe–Lamb equations are incorrect. (Diss. Abstr. Int., B)

46343 FINE STRUCTURE OF THE HELIUM NEGATIVE ION. Mader, D. L.; Novick, R. (Columbia Univ., New York). Phys. Rev. Lett.; 29: No. 4, 199-202(24 Jul 1972).

Fine-structure transitions were observed in the metastable (1s2s2p) ^4P_J state of the negative helium ion $^4He^-$ using an rf resonance technique. Preliminary determinations were made of the energy separations: $|E_{5/2} - E_{3/2}| = 825.23 \pm 0.82$ MHz and $|E_{3/2} - E_{1/2}| = 8663 \pm 56$ MHz. It is shown that the $J = 3/2$ level lies between the $5/2$ and $1/2$ levels. These results are to be compared with the current theoretical estimates of $E_{5/2} - E_{3/2} = -2030$ MHz and $E_{3/2} - E_{1/2} = -9410$ MHz. (auth)

46344 HIGHER MULTIPOLE COEFFICIENTS OF THE HYDROGEN–HYDROGEN INTERACTION AS DETERMINED BY DYNAMIC MULTIPOLE POLARIZABILITIES. Venanzi, Thomas J. (Univ. of

California, Santa Barbara). Phys. Rev. Lett.; 29: No. 4, 197-9(24 Jul 1972).

The Padé approximant is used to calculate the higher multipole coefficients of the hydrogen–hydrogen interaction, with excellent results. However, the rate of convergence is slower and is attributed to the fact that higher excited states contribute more in the higher multipole interactions than in the dipole–dipole case. (auth)

46345 ABSOLUTE MEASUREMENT OF THE LIFETIME OF THE 4^1D LEVEL OF THE HELIUM ATOM USING THE ELECTRON–PHOTON COINCIDENCE METHOD. Peresse, Joseph; Pochat, Amedee; Le Nadan, Andre (Univ., Brest, France). Compt. Rend., Ser. B; 274: No. 12, 791-4(20 Mar 1972). (In French).

The coincidence method is applied to the inelastically scattered electron and the de-excitation photon in the measurement of the lifetimes of excited atomic states. The results obtained for the mean lifetime of the 4^1D level of helium are given. (France)

46346 ORIGIN OF ENERGY BARRIERS IN THE EXCITED STATES OF He_2. Guberman, S. L.; Goddard III, W. A. (California Inst. of Tech., Pasadena). Chem. Phys. Lett.; 14: No. 4, 460-5(15 Jun 1972).

The $A\ ^1\Sigma_u^+$ and $C\ ^1\Sigma_g^+$ states of He_2 were examined using self-consistent (spatially projected) generalized valence bond (GVB) wave functions. Both states were found to have humps (0.06 and 0.22 eV, respectively) at large R (3.1 and 2.1 Å, respectively). The repulsive nature of these states at large R results from nonbonding interactions between the singlet pairs of orbitals located on different centers. For R smaller than the size of the excited He orbital (2s or 2p), the state becomes attractive if the symmetry is such that the wave function can build in attractive He_2^+ ($^2\Sigma_u^+$) character. (auth)

46347 INVESTIGATION OF THE PRESSURE SHIFT OF THE GROUND STATE HYPERFINE LINES OF H, D, AND T. Morgan, Carlisle Lee Jr. New Haven; Yale Univ. (1971). 173p. University Microfilms Order No. 72-17,146.

Thesis.

An optical pumping method for measurement of hydrogen hyperfine pressure shifts was extended by improvements in sample preparation, temperature control, and magnetic field stabilization to yield results with approximately 0.1% accuracy in argon. The shifts for hydrogen were also measured for the first time in krypton and xenon. When the shift is expressed as $(1/\nu_0)\ [(\partial\nu)/\partial\rho)] = (A + BT)$, the results in argon for hydrogen, deuterium, and tritium are $A_H = (-4.800 \pm .006) \times 10^{-9}$/torr (0°C), $B_H = (0.956 \pm .011) \times 10^{-11}$/torr (0°C)/°C, $A_D = (-4.802 \pm .022) \times 10^{-9}$/torr (0°C), $B_D = (1.091 \pm .047) \times 10^{-11}$/torr (0°C)/°C, $A_T = (-4.795 \pm .012) \times 10^{-9}$/torr (0°C), and $B_T = (.929 \pm .021) \times 10^{-11}$/torr (0°C)/°C. The fractional pressure shift for hydrogen is $(-10.4 \pm 0.2) \times 10^{-9}$/torr (0°C) in krypton and $(-20 \pm 2) \times 10^{-9}$/torr (0°C) in xenon between 32°C and 35°C. The results are compared with existing theories for the shift. The absence of any isotope dependence supports existing theories of the shift and encourages comparison with the measurements of muonium hyperfine splitting. The measured linear temperature dependence requires further development of the theoretical models of the shift. (Diss. Abstr. Int., B)

46348 RELAXATION PROCESSES OF THE n = 3 STATES OF HELIUM. Wellenstein, Hermann Fridenant. Austin, Tex.; Univ. of Texas (1971). 107p. University Microfilms Order No. 72-15,851.

Thesis.

The positive column of a discharge through helium serves as a reactor for studying the relaxation processes of the n = 3 states. The critical conditions for appearance or disappearance of striations are expressed in terms of current, pressure, and tube radius as $I = A(pR)^{-5}$. The production mechanism of the molecular ion is studied by mass-analyzing the ion diffusion current through a hole in the side of the tube. Each of the n = 3 states is selectively and periodically modulated by absorption from the metastable states. By monitoring the in-phase changes of the excited states and molecular ion population over a range of discharge current and pressure, rate constants are determined for associative ionization, for excitation transfer by collision with neutrals and with electrons, and for the total neutral collisions. (Diss. Abstr. Int., B)

46349 ELECTRIC DIPOLE POLARIZABILITIES OF LANTHANIDES AND ACTINIDES. Saxena, K. M. S.; Fraga, S. (Univ. of Alberta, Edmonton). J. Chem. Phys.; 57: No. 4, 1800-1(15 Aug 1972).

Electric dipole polarizabilities for the ground states of the lanthanides and actinides and their first three positive ions, calculated using numerical Hartree–Fock functions, are tabulated. Additional calculations were carried out for Ba and Rn for which experimental values are available. The agreement obtained between the present results and experimental values for the latter two elements indicates that the present values should represent a satisfactory prediction of the polarizabilities of the lanthanides and actinides. (A.G.W.)

46350 EFFECTS OF SCREENING AND POLARIZATION ON VIBRATION–ROTATION PROPERTIES OF H_2. Hayes, Stuart F.; Beckel, Charles L. (Univ. of New Mexico, Albuquerque). J. Chem. Phys.; 57: No. 4, 1497-1502(15 Aug 1972).

Eight simple models of H_2 in the ground state are examined through use of Dunham's formulas, numerical integration of the vibrational Schrödinger equation, and the WBK energy condition. These models provide four examples for studying the effects of variable screening and four examples for the effects of polarization on vibration–rotation properties. At small v, variability of the screening parameter α correlates with positive curvatures of the ΔG and B_v curves; i.e., for the four models with $\alpha = 1$ both curvatures are negative, and both curvatures are positive for the four cases with α variable. The dominance of the quartic potential coefficient a_2 in determining near-equilibrium ΔG and B_v curvatures is pointed out. Near dissociation, the presence of polarization causes positive curvature of these two curves. In showing this, large fictitious values of the reduced mass are employed to provide several vibrational levels very close to the dissociation limit. The D_v curves have a pronounced minimum, similar to that of the experimental curve, for α variable but not for $\alpha = 1$. In addition, the values of D_v and H_v are much closer to experiment for α variable than for $\alpha = 1$. (auth)

46351 LONG-RANGE INTERACTIONS BETWEEN TWO HYDROGEN ATOMS AND TWO HELIUM ATOMS. Yamabe, Tokio; Ishimaru, Shingo; Fukui, Kenichi (Kyoto Univ.). Bull. Chem. Soc. Jap.; 45: No. 5, 1384-7(May 1972).

The numerical results of the interaction energy between two hydrogen atoms and two helium atoms are examined with the use of exact formulas for the second-order perturbation energy using the Unsöld approximation. It is found that the analytic expression gives a good long-range interaction energy between two hydrogen atoms comparable to the best variational results so far obtained. In the case of two helium atoms, the result lies in between experimental data for large nuclear distances; this seems to support the reliability of the present estimation. Finally, the effectiveness of the Unsöld approximation is remarked on. (auth)

46352 HYDROGEN ATOM IN A ROTATING ELECTRIC FIELD. Lisitsa, V. S. Opt. Spectrosc. (USSR) (Engl. Transl.); 31: No. 6, 468-9(Dec 1971).

Translated from Opt. Spektrosk.; 31: No. 6, 862-5(Dec 1971).

A calculation was performed of the emission spectrum of a hydrogen atom placed in a homogeneous electric field rotating with a constant angular velocity. The method used to solve the problem, based on the four-fold symmetry of the hydrogen atom, avoids the difficulties related to the secular-equation method and provides a solution for any line. It is shown that the method utilized here can be applied to the collision of hydrogen atoms with charged particles, in particular, to the theory of Stark broadening of hydrogen spectral lines in plasma. (auth)

46353 THEORETICAL STUDIES OF DIAMAGNETIC PROPERTIES OF THE HYDROGEN MOLECULE ION. I. APPROXIMATE VARIATION–PERTURBATION CALCULATION. Garrett, Thomas B.; Zeroka, Daniel (Lehigh Univ., Bethlehem, Pa.). Int. J. Quant. Chem.; 6: No. 4, 651-61(Jul 1972).

A variation–perturbation method, analogous to a technique devised by Das and Bersohn for the study of the hydrogen molecule, is developed for calculation of the diamagnetic susceptibility χ and magnetic shielding σ and is applied to a study of the hydrogen molecule ion. Two approximations are investigated: in a first approximation, $\chi = -0.37814\alpha^2 a_0^3$ and $\sigma = 1.112 \times 10^{-5}$ cgs units and in a second approximation, $\chi = -0.37569\alpha^2 a_0^3$ and $\sigma = 1.128 \times 10^{-5}$ cgs units. (auth)

46354 THEORETICAL STUDIES OF DIAMAGNETIC PROPERTIES OF THE HYDROGEN MOLECULE ION. II. EFFECT OF VARYING INTERNUCLEAR SEPARATION. Garrett, Thomas B.; Zeroka, Daniel (Lehigh Univ., Bethlehem, Pa.). Int. J. Quant. Chem.; 6: No. 4, 663-8(Jul 1972).

The diamagnetic susceptibility χ and magnetic shielding σ for H_2^+ are investigated in the range of internuclear separations R = 1.6 to 2.4 au according to a previously reported technique. From these data values of $\langle\chi\rangle$ and $\langle\sigma\rangle$, for which nuclear motion due to zero-point vibration and centrifugal stretching is taken into ac-

count, are calculated at 300°K. These averages are $\langle\chi\rangle = -0.3902\ \alpha^2 a_0^3$ and $\langle\sigma\rangle = 1.096 \times 10^{-5}$ cgs units, which are approximately 3.1% and 1.4%, respectively, smaller than the equilibrium values. (auth)

46355 SIMPLE PERTURBATION AND PERTURBATION–VARIATION TREATMENTS OF THE $1s\sigma_g$ AND $2p\sigma_u$ STATES OF H_2^+. Tung, Eleanor W.; Sanders, William A. (Catholic Univ. of America, Washington, D. C.). Int. J. Quant. Chem.; 6: No. 4, 717-23(Jul 1972).

First-order wave functions and binding energies of the $1s\sigma_g$ and $2p\sigma_u$ states of H_2^+ are calculated by simple methods for internuclear separations between 0.2 and 10 a_0. An exact perturbation treatment of the $1s\sigma_g$ state with a zeroth-order function of the form $N \exp(-sR\lambda/2) \exp(sR|\mu|/2)$ yields only fair results. An alternative method starts with zeroth-order functions of the form $N \exp(-sR\lambda/2)[\exp(-sR\mu/2) \pm \exp(sR\mu/2)]$ for the $1s\sigma_g$ and $2p\sigma_u$ states, respectively. An approximate first-order trial function is set up and the energies are determined variationally. For both states the results are comparable to those obtained by exact perturbation treatments of the same order. (auth)

46356 MULTIPHOTON TRANSITION IN HYDROGEN BETWEEN 1S AND 2P LEVELS. Rahman, Naseem K.; Reiss, Howard R. (American Univ., Washington, D. C.). Phys. Rev., A; 6: No. 3, 1252-5(Sep 1972).

1S–2P multiphoton transition amplitudes are calculated for hydrogen atoms in the presence of an intense electromagnetic field. Nonlinear behavior of the transition amplitudes appears as in the case of 1S–2S transitions considered earlier. (auth)

46357 RETARDED VAN DER WAALS POTENTIAL BETWEEN PAIRS OF SPINLESS ATOMS. Au, Chi-kwan E. (Columbia Univ., New York). Phys. Rev., A; 6: No. 3, 1232-8(Sep 1972).

The retarded van der Waals potential between pairs of spinless atoms, H–H, H–He, He–He, Ne–Ne, Ne–Ar, and Ar–Ar, was computed with covariant formulas of Feinberg and Sucher. Electric and magnetic effects were treated on equal footing. For hydrogen, which possesses a large magnetic polarizability, magnetic effects dominate for large distance of separation, and for small distances, an additional contribution to the London constant for a pair of hydrogen atoms from the magnetic effects is found to be $0155\alpha_{as}$, about 0.24% of the currently accepted value. (auth)

46358 MOLECULAR-BEAM MAGNETIC-RESONANCE MEASUREMENTS OF THE ANISOTROPIES OF THE ELECTRIC POLARIZABILITIES OF H_2 AND D_2. MacAdam, K. B.; Ramsey, N. F. (Harvard Univ., Cambridge, Mass.). Phys. Rev., A; 6: No. 3, 898-906(Sep 1972).

The anisotropies $\gamma = \alpha_{||} - \alpha_{\perp}$ of the static electric polarizabilities of H_2 and D_2 were measured in a molecular-beam magnetic-resonance experiment. The quadratic Stark shifts of the separated-oscillatory-field resonances in the ground electronic and vibrational and $J = 1$ rotational states were measured in parallel electric and magnetic fields. The results are $\gamma(H_2) = 0.3016 \pm .0005$ Å and $\gamma(D_2) = 0.2917 \pm .0004$ Å^3, which agree very closely with theory. A previously measured combination of the spin-rotation and quadrupole-interaction constants of D_2 was independently remeasured, and the dependence upon orientation of the nuclear magnetic shielding of D_2 was found to be $\sigma_{\perp 1} - \sigma_0 = -11 \pm 9$ ppM. An efficient electron-bombardment detector was constructed for this experiment. (auth)

46359 ANALYTIC CALCULATION OF THE COHERENT ATOMIC SCATTERING FACTOR FOR THE GROUND STATE OF THE HELIUM ISOELECTRONIC SEQUENCE. Sahni, V. (Polytechnic Inst. of Brooklyn); Krieger, J. B. Phys. Rev., A; 6: No. 3, 928-36(Sep 1972).

The analytical method developed by the authors for the determination of the expectation value of single-particle operators $W = \Sigma_i W(\vec{r}_i)$ correct to second order is employed in both the first and second decoupling approximations to obtain analytic expressions for the coherent x-ray scattering factor $F(\vec{k})$ for the ground state of the helium isoelectronic sequence valid for all values of momentum transfer. The trial wave function ψ_{0T} employed is an energy-minimized Hartree product of hydrogenic states. For helium the results for the form factor in the second decoupling approximation are found to be superior to those of the first, are within 1.2% of the highly accurate values calculated using a 120-parameter configuration-interaction wave function, and have an accuracy equivalent to that of an analytical Hartree–Fock treatment. This error is further reduced as the atomic number is increased. In order to demonstrate the internal self-consistency of the technique, it is shown that the expectation value of any single-particle operator as obtained by direct use of the analytical method is the same as the expectation value obtained employing the form factor, provided that the latter has also been calculated by the analytical method employing the same trial wave function. Finally, the calculations are extended to the infinite-momentum-transfer range and the results are studied in this limit by employing a cusp condition for the exact ground-state wave function of two-electron atomic systems written in terms of the logarithmic derivative of the electron density at the origin. It is observed that in the infinite-momentum-transfer limit the results for helium are in error by 0.57% and that this error is further diminished for each successive element of the isoelectronic sequence. In addition, it is noted that the cusp condition is exactly satisfied via the formalism of the second decoupling approximation and is independent of the variational parameter employed. (auth)

46360 SECOND-ORDER CORRECTIONS TO THE FINE STRUCTURE OF HELIUM. II. CONTRIBUTIONS FROM ^1P AND ^3D INTERMEDIATE STATES. Hambro, Lars (Univ. of California, San Diego, La Jolla). Phys. Rev., A; 6: No. 3, 865-70(Sep 1972).

The contributions from the three spin-dependent Breit operators in second-order perturbation theory are calculated when the symmetries of the intermediate states are odd ^1P or ^3D. Standard Hylleraas expansions with up to 165 terms are used for the perturbations of the wave functions. The large interval of the fine structure of the $2\ ^3P$ level in helium is increased by $2.17(2) \times 10^{-4}$ cm^{-1} by ^1P and by $0.0089(6) \times 10^{-4}$ cm^{-1} by ^3D. Two methods for handling angular integration over D tensors are described. (auth)

46361 LINEAR STARK EFFECT DUE TO RESONANT INTERACTIONS OF STATIC AND DYNAMIC FIELDS. Cohn, Arthur (Air Force Cambridge Research Labs., Bedford, Mass.); Bakshi, P.; Kalman, G. Phys. Rev. Lett.; 29: No. 6, 324-7(7 Aug 1972).

The line shape of the Lyman-α transition of a hydrogen atom simultaneously subjected to a static and a perpendicular high-frequency electric field was investigated. It was found that resonance effects occur, producing a profile substantially different from the Stark spectrum of the fields acting independently. This result shows that the interpretation of turbulent hydrogen plasma spectra by the Blokhintesev (dynamic field only) theory is not generally valid. (auth)

Positronium, Muonium, and Mesic Atoms and Molecules

Refer also to abstracts 46372, 46571, 46708, 47031, and 47245.

46362 (RISO–254) POSITRON LIFETIMES IN WATER AND ICE, AND IN FROZEN AQUEOUS SOLUTIONS. Eldrup, Morten (Danish Atomic Energy Commission, Risoe. Research Establishment. Tekniske Hoejskole, Lyngby (Denmark)). Nov 1971. 115p. Dep. NTIS (U. S. Sales Only).

Thesis.

An introduction to the subject is given, the principle of lifetime measurements is discussed, and the experimental apparatus is described. A computer program used for data analysis is described and the problems involved in the analysis are discussed. All lifetime spectra are resolved into three components. For H_2O the long lifetime, attributed to ortho-positronium, is 0.68 ns in ice between −196 and 100°C, increases to 1.12 ns at 0°C, and abruptly to 1.86 ns upon melting. Its relative intensity is 52% in ice and 27% in water. Spectra for heavy ice are identical with those for light ice, whereas heavy water gives 2.01 ns, 22%. The increase in lifetime in ice above −100°C is attributed to trapping of positronium in temperature-created defects. Spectra for frozen aqueous solutions of concentrations above 10^{-2} mole fraction contain at −160°C a long-lived component attributed to the trapping of positronium. Very good agreement with the trapping model is obtained for HF solutions, both fast frozen and annealed. An irreversible change in the spectrum takes place by heating a fast frozen HF solution above approximately −125°C. (112 references) (auth)

46363 PHASE AND TEMPERATURE DEPENDENCE OF POSITRON ANNIHILATION IN LIQUID CRYSTALS. Nicholas, J. Blair; Ache, Hans J. (Virginia Polytechnic Inst. and State Univ., Blacksburg). J. Chem. Phys.; 57: No. 4, 1597-1603(15 Aug 1972).

Positron lifetime measurements were carried out in a series of liquid crystalline compounds. The resulting lifetime spectra were decomposed into two components. The short-lived component (lifetime τ_1 and intensity I_1) was attributed to free-positron and para-positronium annihilation where the long-lived component (τ_2,I_2)

was considered to be the result of orthopositronium annihilation. Changes of τ_2 and I_2 during mesomorphic phase transitions are generally very small and can be related to the transition entropies involved, supporting the contention that the positron annihilation process is affected by variations in the structural regularities of the environment. Various mechanisms that could account for the observed changes of the positron lifetimes and their intensities at the phase-transition points are discussed. (auth)

Collision Phenomena

Refer also to abstracts: 46280, 46348, and 46721.

46364 (ORNL-TM-3839) LOW-ENERGY ELECTRON ATTACHMENT TO MOLECULES AT HIGH DENSITIES. McCorkle, D. L.; Christophorou, L. G. (Oak Ridge National Lab., Tenn.). Jul 1972. Contract W-7405-eng-26. 87p. Dep. NTIS.

Thesis. Submitted by D. L. McCorkle to Tennessee Univ., Knoxville.

Low-energy electron attachment to a number of polyatomic molecules was studied using the electron swarm method. Electron-attachment rates were measured for sulfur hexafluoride (SF_6) and molecular oxygen (O_2). Electron-attachment cross sections, determined by assuming an analytic form of the cross section, for anthracene, 1,2-benzanthracene, 1,4-naphthoquinone, and sulfur hexafluoride are reported and discussed. A new swarm-unfolding method for determining electron-attachment cross sections was developed. This was applied for the determination of the attachment cross sections for carbon tetrachloride, n-bromodecane, 1,4-naphthoquinone, and 1,2-benzanthracene, which increase sharply at thermal energies. Also, it was applied for the determination of the cross sections for the production of O^- from O_2 and O^- from N_2O, which lie at higher energies. The attachment cross section for the formation of O_2^- with increasing N_2 density in O_2-N_2 mixtures was determined. At low densities this cross section exhibits distinct structure attributed to electron capture into vibrational states of O_2^-. (auth)

46365 (ORO-2911-14) INTERACTION OF HEAVY keV IONS WITH MATTER. Progress Report. Boring, John W. (Virginia Univ., Charlottesville. Research Labs. for the Engineering Sciences). Jun 1972. Contract AT(40-1)-2911. 27p. (AEEP-3930-109-72-U). Dep. NTIS.

Work during the period in four areas is summarized: (1) a critical review of calculations of the effects of heavy-particle penetration, including the relative importance of electronic and nuclear energy transfer processes; (2) investigation of the use of the binary-encounter method for calculating electronic stopping cross sections; (3) a study of the dependence of nuclear trajectories in heavy-particle collisions on the inelastic character of the events; and (4) use of the binary-encounter method for calculating the inactivation cross section for enzyme molecules. Figures show results on the following: comparison of three potentials (Bohr, Thomas–Fermi, and modified Thomas–Fermi) for calculation of average energy going to electronic processes in Ar–Ar and U–U collisions; electronic stopping cross sections for 0.1-, 0.8-, and 10.0-MeV helium as a function of target Z; calculated reduced cross sections for H^+–Ar and H^+–Kr scattering; cross sections for inactivation of RNase by protons at 0.1 to 100 keV. (A.G.W.)

46366 IONIZING COLLISIONS OF FAST ALKALI ATOMS WITH Cl_2, Br_2, AND O_2. Kashihira, Nobuyuki. Lafayette, Ind.; Purdue Univ. (1971). 147p. University Microfilms Order No. 72-7976.

Thesis.

A time-of-flight apparatus is described for measuring the inelastic energy loss incurred by fast (<50 to 350 eV) alkali atoms in ionizing collisions with diatomic molecules. The inelastic energy losses were found to be nearly energy-independent for collisions of K and Cs with Cl_2, Br_2, and O_2, and it is furthermore shown that these energy losses are from about 8 to 10 eV, irrespective of the reactants. The collisions between alkali atoms and halogen molecules (Cl_2 and Br_2) yield intermediate alkali ions (M^+) and excited molecular ions (X_2^-) in the $^2\Sigma_g$ state, followed by dissociation to the ground-state halogen ions and excited halogen atoms. In the case of oxygen, excited molecular ions in the $^2\pi_u$ state are formed, and these species either remain in the bound state of the $^2\pi_u$ or decay to vibrationally excited molecular states ($^b\Sigma_g^+$, $^a\Delta_g$). The excitation functions (change of cross sections with incident energy variations) are interpreted in terms of curve crossings near or inside the equilibrium distance of the $M-X_2$ potential surfaces. A comparison of the results obtained at high energies (20 to 200 eV cm) is made to those known from collision energies between 1 and 20 eV (cm), and a composite excitation function for the three most probable processes over the whole energy range is constructed. (Diss. Abstr. Int., B)

46367 ENERGY AND ANGULAR DISTRIBUTIONS OF SECONDARY ELECTRONS RESULTING FROM IONIZING COLLISIONS OF ELECTRONS WITH HELIUM AND KRYPTON. Oda, Nobuo; Nishimura, Fumio; Tahira, Sadamu (Tokyo Inst. of Tech.). J. Phys. Soc. Jap.; 33: No. 2, 462-7(Aug 1972).

Cross sections differential in angle and energy were measured for secondary electrons resulting from ionizing collisions of electrons with helium at primary energies E_0 = 500 eV and 1 keV and with krypton at E_0 = 1 keV. The total spectra, consisting of the continuum spectra due to direct ionizations and the sharp line spectra due to indirect ionizations (autoionizations or Auger processes), were measured with an energy resolution of about 0.2 eV over the angular range from 10° to 130°. The continuum spectra are derived from the total spectra for electron energies from 25 to 45 eV for helium and from 24 to 52 eV for krypton and compared with calculations by the binary encounter theory. (auth)

46368 OSCILLATIONS OF THE CHARGE-EXCHANGE CROSS SECTION IN THE SYSTEM Li^+–He. Latypov, Z. Z.; Shaporenko, A. A. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 1, 114-16(Jul 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 1, 147-50(Jan 1972).

The cross section for the charge-exchange process $Li^+ + He \rightarrow Li + He^+$ was studied experimentally over the range of Li^+ energies $600 \leq E \leq 2800$ eV; the cross section oscillates. The relationship between these oscillations of the charge-exchange cross section and those of the helium-atom excitation cross section in the process $Li^+(1s^2) + He(1s^2) \rightarrow Li^+(1s^2) + He(1s2s)$ is discussed. (auth)

46369 RELATIONS BETWEEN SOME EXPONENTIAL APPROXIMATIONS IN ROTATIONALLY INELASTIC MOLECULAR COLLISIONS. Pack, R. T. (Brigham Young Univ., Provo, Utah). Chem. Phys. Lett.; 14: No. 4, 393-5(15 Jun 1972).

Relationships between the infinite-order sudden (or strong-coupling), the first-order sudden, and the exponential distorted-wave approximations are derived and discussed. The resulting S matrices for an atom–diatom rotationally inelastic collision are compared. (auth)

46370 COUPLED STATE CALCULATIONS FOR PROTON–HYDROGEN SCATTERING IN THE READING REPRESENTATION. Zimmerman, Ivan Harold. Seattle; Univ. of Washington (1972). 318p. University Microfilms Order No. 72-20,904.

Thesis.

The problem of proton scattering by atomic hydrogen is considered in the semiclassical impact-parameter approximation. The electron wave function is written as a sum over a specific set of expansion functions, which represent channels through which the electron probability may flow during the course of the collision. These channels are all closely coupled by the hamiltonian for the system and are centered on the two protons. An introductory chapter attempts to give both a historical and a theoretical background to the impact-parameter approximation. In the second chapter the coupled equations are derived. Symmetries of the system are utilized in reducing the amount of work to be done. The radial part of the expansion basis function ϕ_k (r) is chosen to be a Slater orbital $r^l e^{-\lambda} k^r$, but with the parameter λ_k chosen according to particular criteria. With the set of λ's so chosen, the radial functions are called Reading functions, and the representation of the electron wave function in terms of these orbitals is called the Reading representation. Using this representation, simplified expressions for the numerically evaluated exchange matrix elements may be obtained, which greatly increase the speed of computation. An additional refinement to the program is the utilization of the time-transition matrix $U^\pi(t,t_0)$, which relates $a_k^\pi(t)$, the probability amplitude for occupation of the kth orbital with parity symmetry $\pi = \pm 1$, to the earlier amplitudes $a_k^\pi(t_0)$. A complete set of preliminary results is obtained and compared to existing experimental and theoretical work. It is seen that a 6-state expansion, as was used in deriving the results in chapter IV, is not sufficient to guarantee good general accuracy and that convergence of calculated results is not apparent until some 7 states are included in the l = 0 angular momentum symmetry with perhaps 4 states in the l = 1 spectrum for each of m = 0 and m = 1. In chapter V an extensive program of large-scale computation is proposed, and refinements to the theoretical formulation of the problem are suggested and considered. (TSS) (Diss. Abstr. Int., B)

46371 OPTICAL EXCITATION FROM LOW-ENERGY $He^+ + H_2$ AND $H_2^+ +$ He COLLISIONS. Nathan, Richard David. Gainesville, Fla.; Univ. of Florida (1971). 135p. University Microfilms Order No. 72-16,638.

Thesis.

Observations of spectra and measurements of cross sections and polarization of emission arising from collisions of $He^+ + H_2$ and $H_2^+ + He$ were made in order to examine the processes of direct excitation, dissociative excitation, dissociative charge-transfer excitation, and charge exchange into excited states. Optical spectra from both collision processes, investigated in the wavelength region from 3500 to 7500 Å, revealed strong production of the Balmer series of atomic hydrogen and lines of neutral helium. Cross sections were determined from 30 to 700 eV for Balmer α and β emissions and for the $3^3D \rightarrow 2^3P^0$, $4^3D \rightarrow 2^3P^0$, and $3^1D \rightarrow 2^1P^0$ transitions of helium from $He^+ + H_2$ and for Balmer α, β, and γ and the $3^1D \rightarrow 2^1P^0$ and $3^3D \rightarrow 3^3P^0$ transitions of helium from $H_2^+ + He$ collisions. The Balmer α and β curves from the $He^+ + H_2$ reaction were the only ones that exhibited maxima in the low-energy region investigated. Measurements of the Balmer α emission cross section as a function of energy of the ionizing electrons in the case of $H_2^+ + He$ indicated the necessity of considering the vibrational state of the projectile in the dissociative excitation process. The polarization of Balmer α and β emission was determined for both reactions from bombarding energies of 40 to 700 eV. The detection of Balmer α polarization arising from $He^+ + H_2$ collisions is the first observation of polarized emission resulting from the process of dissociative charge transfer. (Diss. Abstr. Int., B)

46372 POSITRON–HYDROGEN COLLISIONS AND POSITRONIUM FORMATION. Abu-Wakid, Shukri Edward. Baton Rouge, La.; Louisiana State Univ. (1971). 120p. University Microfilms Order No. 72-17,741.

Thesis.

In Part I a modified close-coupling method is suggested in order to incorporate polarization effects in low-energy scattering. It is applied to e^+–H collisions for energies below the n = 3 threshold of hydrogen. S-, p-, and d-wave elastic phase shifts and inelastic cross sections are calculated. Results show a fair improvement over those of close coupling. In Part II the algebraic close-coupling method is used to calculate the s-wave phase shifts and positronium-formation cross section for various types of close-coupling expansions of the total wave function. The positronium channels are included explicitly, and polarization effects in both the hydrogen and positronium atoms are incorporated by pseudostates that give the full ground-state polarizabilities. (Diss. Abstr. Int., B)

46373 SECOND BORN ZERO-ANGLE DIFFERENTIAL CROSS SECTIONS IN HIGH-ENERGY LIMIT FOR ELECTRON-IMPACT EXCITATION OF He: THE 2^3S–1^1S AND 2^3P–1^1S TRANSITIONS. Bonham, R. A. (Indiana Univ., Bloomington). J. Chem. Phys.; 57: No. 4, 1604-12(15 Aug 1972).

The high-energy limit of the inelastic differential cross section for the excitation of the 2^3S and 2^3P states of He from the ground state in the forward direction is investigated by expanding the T matrix in powers of V about zero scattering angle and considering all terms proportional to V and V^2 where V is the interaction potential. It is shown that the leading terms in a power series in the reciprocal of the incident energy in this second Born infinite-channel close-coupling theory can qualitatively account for the observed enhancement of the exchange cross section in the forward direction over the predictions of the first Born theory. The ratio of the square of the leading second Born term to the square of the leading first Born term is shown to be proportional to the incident energy for the $2^3S \leftarrow 1^1S$ transitions and of the same order in the incident energy as the first Born form in the case of the $2^3S \leftarrow 1^1S$ transition. The value of the ratio at 500 eV for the $2^3S \leftarrow 1^1P$ transition is estimated to be close to 100 and is relatively independent of the choice of an effective energy-loss parameter introduced to carry out the sum over intermediate states. (auth)

46374 IONIZATION OF ARGON BY ELECTRON IMPACT. Crowe, A.; Preston, J. A.; McConkey, J. W. (Univ. of Windsor, Ont.). J. Chem. Phys.; 57: No. 4, 1620-5(15 Aug 1972).

The ionization efficiency curves for Ar^+ and Ar^{2+} were measured for electron energies from threshold to 300 eV. Structure in the Ar^+ curve was confirmed and arguments and evidence are put forward to support the view that this structure is due to production of the ion via various channels (in particular the autoionization channels) rather than to "competition" between the Ar^+ and Ar^{2+} channels as has been suggested recently. (auth)

46375 OPTICAL MODEL FOR VIBRATIONAL RELAXATION IN REACTIVE SYSTEMS. Poulsen, Lise Lotte; Ross, John; Steinfeld, Jeffrey I. (Massachusetts Inst. of Tech., Cambridge). J. Chem. Phys.; 57: No. 4, 1592-7(15 Aug 1972).

The probabilities for vibrational transitions in the presence of open reactive channels are calculated with an optical model. A linear collision of an atom and a diatomic molecule is considered. The distorted-wave Born series is derived, and an analytic expression is given for the first-order result for an exponential repulsive potential. A semiclassical analysis is also presented. The results are applied to an electronically excited I_2 molecule colliding with an inert atom. The vibrational transition probabilities are found to be appreciably affected only in the few cases where the predissociation probability is very high, that is larger than about 0.3. (auth)

46376 ACOUSTIC MEASUREMENTS OF ROTATIONAL ENERGY TRANSFER. Bauer, H.-J.; Bass, H. E. (Univ. of Mississippi, University). J. Chem. Phys.; 57: No. 4, 1763-6(15 Aug 1972).

The problem of using acoustic measurements to determine rotational energy transfer rates was examined. A method to link the rate of energy transfer to the acoustic behavior of the gas was developed and applied to the collision model of Raff and Winter. The results in the case of H_2 demonstrate the importance of using an accurate acoustical treatment when testing a reaction model. (auth)

46377 RETARDATION EFFECTS IN LOW-ENERGY ATOM–ATOM SCATTERING. Konrady, John Andrew Jr. College Park, Md.; Univ. of Maryland (1972). 92p. University Microfilms Order No. 72-20,254.

Thesis.

The feasibility of detecting retardation effects in low-energy helium–helium scattering is studied. Differential and total cross sections for the elastic scattering of helium atoms at very low energies are computed with and without retardation effects considered. Differences between the retarded and unretarded total and forward differential cross sections exceed 3% in an energy range in which low-resolution experiments have already been performed. The calculations are based on the Bruch–McGee semi-empirical potential and a modified version of this potential utilizing the O'Carroll–Sucher arc-tangent approximation to the Casimir–Polder potential. New bounds on the second term in Born series for the partial wave amplitudes are presented. Also, a regularization scheme for the Born approximation to the scattering amplitudes for singular potentials is developed. (Diss. Abstr. Int., B)

46378 FORMATION OF EXCITED HYDROGEN ATOMS BY CHARGE-TRANSFER NEUTRALIZATION OF HIGH-ENERGY PROTONS. Ford, John Charles. Atlanta; Georgia Inst. of Tech. (1971). 182p. University Microfilms Order No. 72-19,703.

Thesis.

Absolute cross sections for the formation of atomic hydrogen in the 3s, 3p, and 3d states of excitation resulting from the impact of 75- to 350-kilovolt protons with various gaseous targets such as hydrogen, nitrogen, argon, and helium were measured with greater accuracy than heretofore possible. In addition, a number of more complicated molecular targets such as methane, ethane, propane, carbon dioxide, carbon monoxide, and nitric oxide were used to produce 3s-state excitation with the objective of establishing simple empirical rules for predicting molecular cross sections in terms of the cross sections for the constituent atoms. Considerable effort was directed toward providing a vivid understanding of many of the associated processes affecting the formation and decay of excited projectiles. Finally, a study of the formation of excited hydrogen by the dissociation of H_2^+ and H_3^+ projectiles was made. A collimated beam of protons was allowed to traverse a differentially pumped target cell. The Balmer alpha radiation from the emerging beam displayed a distinctive spatial profile. From this profile the relevant cross sections were inferred via a mathematical deconvolution procedure. The relative production of the 3s, 3p, and 3d states of excitation was found to be nonstatistical; further, it was found that production of lower angular momentum states is preferred. The ratios of the cross sections for producing 3s, 3p, and 3d states by charge transfer are in disagreement with existing theory for the neutralization of protons by helium. No simple rules were found for predicting the production of 3s hydrogen by the charge-transfer neutralization of protons by complicated molecular targets. The dissociation of H_2^+ and H_3^+ was found to produce an abundance of 3p and 3d state hydrogen; this contrasted strongly with the production of hydrogen by charge transfer. (Diss. Abstr. Int., B)

46379 QUANTUM-MECHANICAL SCATTERING OF ASYMMETRIC MOLECULES. II. COMPARISON BETWEEN THE SYSTEMS He–D_2 AND He–HT. Heukels, W. F.; van de Ree, J. (University of Tech., Eindhoven, Netherlands). J. Chem. Phys.; 57: No. 4, 1393-99(15 Aug 1972).

Exact quantum mechanical coupled-channel calculations were performed in order to compare the rotating potential model for heteronuclear molecules with an asymmetric mass distribution and the usual potential with anisotropy terms for homonuclear molecules. The scattering cross sections of He–D_2 and He–HT

show no difference in shape, apart from some quenching of the orbiting resources. There is, however, a significant difference in absolute magnitude, due predominantly to inelastic processes. In the inelastic cross sections, the effect of the shift of the center of mass from the center of interaction in asymmetric molecules counteracts the effect of a change in moment of inertia. (auth)

46380 SCATTERING BY AN r^{-2n} POTENTIAL IN THE BORN APPROXIMATION AND APPLICATION TO DIPOLE–QUADRUPOLE SCATTERING. Ganas, P. S. (California State Coll., Los Angeles). J. Chem. Phys.; 57: No. 4, 1406-7(15 Aug 1972).

By using the Born approximation, an analytic formula is derived for the phase shifts δ_l for scattering by a potential with an r^{-2n} tail. The low-energy properties of the phase shifts are discussed, and an expansion of tan δ_l in powers of k is presented. The dipole–quadrupole r^{-6} potential is discussed as a special case. (auth)

46381 MULTIPLE-SCATTERING EFFECTS IN HIGH-ENERGY ELECTRON–MOLECULE COLLISIONS. II. POLYATOMIC MOLECULES. Yates, Albert C. (Indiana Univ., Bloomington). J. Chem. Phys.; 57: No. 4, 1686-93(15 Aug 1972).

The Glauber theory of multiple scattering is applied to the elastic collisions of fast electrons with polyatomic molecules in an effort to explain deviations between theory and experiment in recent molecular structure determination by electron diffraction. The full scattering amplitude is developed inclusive of all double-scattering contributions, with the differential cross section for the process given up to terms representative of the interference between single and double scattering. For sufficiently energetic incident electrons, the multiple-scattering contributions to the differential cross section are shown to reduce to simple analytic forms. In particular, the three-atom single–double interference term is shown to be an oscillatory function of momentum transfer. Application of the approximate formulas to the rhenium hexafluoride molecule gives excellent agreement with the experimental results of Jacob and Bartell. (auth)

46382 MONTE CARLO TRAJECTORY CALCULATIONS OF THE THREE-BODY RECOMBINATION AND DISSOCIATION OF DIATOMIC MOLECULES. Shui, Ven H. (Massachusetts Inst. of Tech., Cambridge). J. Chem. Phys.; 57: No. 4, 1704-17(15 Aug 1972).

The modified phase-space theory of reaction rates was applied to the problem of the three-body recombination and dissociation of diatomic molecules. The results illustrate the important influence of the weak attractive minimum in the third-body interaction potential and the effect of barrier penetration for recombination at low temperatures. The system N_2 + Ar was used as a typical illustrative example, and good agreement was obtained between the theoretical predictions and the experimental measurements of the reaction rate coefficients over the temperature range 200 to 12,000°K. The recrossing factor and the nonequilibrium factor were obtained from Monte Carlo trajectory calculations for states near the dissociation limit. The trajectories were sampled within the reaction zone with a weight proportional to the equilibrium reaction rate and numerically integrated in both timewise directions to determine the complete histories of the collisions. A simple, separable function for the equilibrium transition rate $R(\epsilon_i,\epsilon_f)$ from initial energy states ϵ_i to final energy states ϵ_f, which could be characterized by three parameters, was obtained to fit the numerical data and was used to solve the steady-state master equation. Distributions of the trajectories with respect to energies and impact parameters are presented, and several typical trajectories are shown to illustrate the important features of the collisions. The contribution to the overall reaction rate from the "complex mechanism" was also obtained. (auth)

46383 COMPOUND ATOM STATE IN NEON. BOUND-STATE CALCULATION OF RESONANCE ENERGY. Foglia, C. (CNR, Parma, Italy. Univ., Parma, Italy). Nuovo Cim.; 10B: No. 1, 348-54(11 Jul 1972).

The first resonance energy in elastic electron scattering from neon is estimated from a single-configuration Hartree–Fock calculation of the resonance state. Radial wave functions and other related parameters for the Ne^- ion in the configuration $(2p)^5\,(3s)^2\,{}^2P$ are tabulated. (auth)

46384 PARTIAL IONIZATION CROSS SECTIONS OF CARBON DIOXIDE BY ELECTRONS (25 to 600 eV). Adamczyk, B. (Maria Curie-Sklodowska Univ., Lublin); Boerboom, A. J. H.; Lukasiewicz, M. J. Mass Spectrom. Ion Phys.; 9: No. 4, 407-12(Sep 1972).

Measurements were made of the partial ionization cross sections of CO_2^+, CO^+, O^+, C^+, and O_2^+, originating from ionization of CO_2 by electrons of 25 to 600 eV. Total collection of these ions was achieved by using a cycloidal mass spectrometer. The relative measurements were normalized, using absolute values of the total cross sections from the literature. (auth)

46385 THIRD-DERIVATIVE METHOD FOR DETERMINING ELECTRON-IMPACT ONSET POTENTIALS. Finney, C. D.; Harrison, A. G. (Univ. of Toronto), J. Mass Spectrom. Ion Phys.; 9: No. 3, 221-33(Aug 1972).

In an attempt to overcome the resolution problems of the Morrison second-differential method of determining ionization and appearance potentials from ionization efficiency data, the procedure of taking a third derivative was investigated both theoretically and experimentally. The results obtained indicate that the technique assists in revealing structure in the second-derivative curves and, in most cases studied, permits estimation of onset potentials in good agreement with photoionization and monoenergetic electron impact values. The limitations of the technique are discussed. (auth)

46386 MULTIPLE IONIZATION OF RARE GAS CLUSTERS BY ELECTRON IMPACT. Obert, W. (Univ., Karlsruhe, Ger. Kernforschungszentrum, Karlsruhe, Ger.). J. Mass Spectrom. Ion Phys.; 9: No. 3, 295-7(Aug 1972).

Condensed molecular beams (clusters beams) of the rare gases neon, argon, and xenon are ionized by electron impact. The mass-to-charge ratio of the cluster ions is determined in a retarding-field analyzer as a function of the electron energy. It is found that the probability of multiple ionization by one electron increases in the order Ne, Ar, Xe. This result is consistent with predictions based on the model for cluster ionization developed by Falter et al. (auth)

46387 INVERSION FROM THE ENERGY DEPENDENCE OF TOTAL CROSS SECTIONS. Guha, Evelyn; Ray, Swati; Barua, A. K. (Indian Association for the Cultivation of Science, Calcutta). J. Phys. Soc. Jap.; 33: No. 2, 468-72(Aug 1972).

The suitability of a recently suggested method for the inversion from the energy dependence of total-cross-section data at high energies was critically examined by considering He–He system. For this purpose, the data had to be generated partially by theoretical calculations. The results of the analysis show that the method has excellent potentialities, provided the required experimental data are available. Some suggestions for performing such experiments are given. (auth)

46388 ANGULAR DISTRIBUTION OF H(2s) FORMED BY ELECTRON CAPTURE AND DISSOCIATION COLLISIONS. Fitzwilson, Roger Louis. Atlanta; Georgia Inst. of Tech. (1971). 189p. University Microfilms Order No. 72-19,702.

Thesis.

The differential cross section for the formation of hydrogen atoms in the metastable 2s state was measured for electron-capture and dissociation collisions. The reactions were studied for impact energies between 4 and 20 keV and scattering angles between 0.5 and 3 degrees. For the electron-capture reaction, the single projectile–target combination of H^+ and He was studied. For the dissociation work, collisions involving projectiles of H_2^+ and H_3^+ and targets of H_2 and He were studied. For comparison with previous theoretical and experimental work on electron capture, the differential cross sections for the formation of H^+ and H° were also measured. From the three cross sections, the probability P_{2s} for the formation of H(2s) and the probability P_0 for the formation of H° were found. The fractional metastable content of the scattered neutral flux P_{2s}/P_0 was also evaluated and compared with existing theory. Similar probabilities were formed for the dissociation processes and compared with the electron-capture results. All differential cross sections for electron capture were found to be smoothly varying functions of scattering angle. The data fit curves of the form $K\theta^{-n}$ where n ranged from 2.5 to 3.2, depending on the energy and the particular cross section. The probabilities P_{2s} and P_0 were found to be fairly independent of scattering angle for angles greater than 0.7 degree but showed oscillatory structure as the impact energy was varied. The metastable fractional content of the scattered neutral flux, P_{2s}/P_0, was found to rise from a small value at low angles to a high value at large angles; the magnitude of the rise depended on the impact energy. The dissociation data were also smoothly varying functions of angle. The differential cross sections for the dissociation of H_2^+ demonstrated a change in slope at scattering angles that could be correlated with known potential energy curves for the H_2^+ molecular ion if Franck–Condon excitations to antibonding states are assumed to be the mode of dissociation. The H_3^+ data showed no such breaks in the differential cross sections. (Diss. Abstr. Int., B)

46389 OPTIMIZED PSEUDOSTATES, INTERMEDIATE-ENERGY SCATTERING, AND COLLECTIVE MODES IN ATOMS. Mittleman, M. H. (City Coll., New York). Phys. Rev., A; 6: No. 3, 879-84(Sep 1972).

In many of the usual methods of calculating scattering ampli-

tudes, a basis set is chosen in which to expand the wave function, and then the coefficients are optimized. The question of how to, in addition, optimize the basis set is considered here. A natural outgrowth of the formalism is the concept of an "average inelastic channel," which could, under certain circumstances, be interpreted as collective mode of excitation of the target. (auth)

46390 SLOW ELECTRONS FROM ELECTRON-IMPACT IONIZATION OF He, Ne, AND Ar. Grissom, J. T.; Compton, R. N.; Garrett, W. R. (Oak Ridge National Lab., Tenn.). Phys. Rev., A; 6: No. 3, 977-87(Sep 1972).

A trapped-electron technique is used to determine the integral cross sections for production of secondary electrons in the energy range from 0 to 1 eV resulting from electron-impact ionization of He, Ne, and Ar. For incident electron energies above 150 eV the slow-electron production cross section decreases approximately as the total-ionization cross section. A simple Born calculation for the case of atomic hydrogen also shows this general behavior. The measured absolute cross sections compare well with recently measured relative angular distributions and with Born and Born-exchange calculations. (auth)

46391 EXCITATION OF THE ELECTRONIC STATES OF THE NITROGEN MOLECULE BY ELECTRON IMPACT. Chung, S.; Lin, Chun C. (Univ. of Wisconsin, Madison). Phys. Rev., A; 6: No. 3, 988-1002(Sep 1972).

The electron-impact excitation cross sections of the a $^1\Pi_g$, c' $^1\Sigma_u^+$, a'' $^1\Sigma_g^+$, $\omega^1\Delta_u$, b' $^1\Sigma_u^+$, b $^1\Pi_u$, A $^3\Sigma_u^+$, B $^3\Pi_g$, C $^3\Pi_u$, D $^3\Sigma_u^+$, W $^3\Delta_u$, and E $^3\Sigma_g^+$ states of N_2 were calculated over the range of 0 to 2000 eV for the singlet states and 0 to 40 eV for the triplet states by means of the Born approximation with Ochkur's and Rudge's scheme for treating the electron-exchange-scattering amplitude. The Franck–Condon-factor approximation was used to obtain the excitation cross sections to each vibrational level of the electronic states. The computation of the scattering-amplitude integrals was greatly facilitated by expressing the molecular wave functions in terms of atomic Gaussian-type orbitals. Four sets of self-consistent-field molecular wave functions were employed for the calculations in order to test the sensitivity of the calculated cross sections to the choice of the wave functions. With the exception of the c' $^1\Sigma_u^+$ state, the cross sections based on three of the four sets vary by typically about 15%. As a test of the Born cross sections for singlet–singlet excitation, comparison between the theoretical and the available experimental values shows 25% agreement for the a $^1\Pi_g$ state at 900 eV and 50% for the a'' $^1\Sigma_g^+$ state at 80 eV. In the case of triplet excitation, the theoretical cross sections of the C $^3\Pi_u$ state agree very well with the experimental data, but for the A $^3\Sigma_u^+$ and B $^3\Pi_g$ states the discrepancy is generally as large as a factor of 2. (auth)

46392 ANGULAR DISTRIBUTION OF ELECTRONS ELASTICALLY SCATTERED FROM N_2. Shyn, T. W.; Stolarski, R. S.; Carignan, G. R. (Univ. of Michigan, Ann Arbor). Phys. Rev., A; 6: No. 3, 1002-12(Sep 1972).

The angular distribution of electrons elastically scattered from N_2 as a function of energy was measured utilizing a crossed-beam technique. Measurements were made of monoenergetic electrons with energies between 5 and 90 eV scattered from a collimated beam of N_2 at angles from −114° to +160°. The wide angular range of the measurements enabled the determination of the total elastic-scattering and momentum-transfer cross sections. The measurements are relative and have been normalized to Fisk's theoretical calculation at 5 eV. The results generally agree well with other published measurements and with theory. (auth)

46393 INELASTIC COLLISIONS OF FAST CHARGED PARTICLES WITH ATOMS: IONIZATION OF THE ALUMINUM L SHELL. Manson, Steven Trent (Georgia State Univ., Atlanta). Phys. Rev., A; 6: No. 3, 1013-24(Sep 1972).

Born-approximation calculations of the ionization of aluminum L-shell electrons were performed using Hartree–Slater wave functions. Generalized oscillator strengths and proton energy-loss cross sections from threshold to ionized-electron energies of 128 Ry were calculated. The results show a delayed maximum above threshold, and the ramifications of this phenomenon are discussed. Comparison is made with hydrogenic results and good agreement is found at intermediate and large energy loss, but the hydrogenic calculation is totally inadequate near threshold. The implications of this for stopping-power calculations and subshell corrections is discussed. The Bethe asymptotic cross section is obtained, and the variation of parameters therein is investigated. (auth)

46394 DE-EXCITATION OF FAST He, Ne, AND Ar METASTABLE ATOMS IN VARIOUS GASES. Moseley, John T.; Peterson, J. R.; Lorents, D. C.; Hollstein, M. (Stanford Research Inst., Menlo Park, Calif.). Phys. Rev., A; 6: No. 3, 1025-31(Sep 1972).

Absolute cross sections for the de-excitation of He(2 ^{1}S) and of He(2 ^{3}S) metastables by N_2 and Ar were measured over the energy interval from 150 to 1600 eV using an optical technique. The 2 ^{1}S cross sections are found to be as much as 50% larger than the 2 ^{3}S cross sections for de-excitation by N_2, whereas for Ar the two cross sections are nearly equal at these energies. The cross sections all lie in the range of 7 to 20 Å^2 and decrease with increasing energy. De-excitation cross sections were also measured by collecting slow ions for mixed beams of He metastables in N_2, Ar, and C_2H_2 and for mixed beams of Ar metastables in C_2H_2 and Ne metastables in Ar. These measurements are in the energy range from 50 to 600 eV. They do not discriminate between different metastable states, but the results exhibit an energy behavior similar to that of the state-separated measurements and are consistent with those measurements when comparison can be made. (auth)

46395 SEMIEMPIRICAL CALCULATIONS OF THE He* (2^3S AND 2^1S) + Ar IONIZATION TOTAL CROSS SECTIONS. Olson, Ronald E. (Stanford Research Inst., Menlo Park, Calif.). Phys. Rev., A; 6: No. 3, 1031-6(Sep 1972).

The ionization (associative and Penning) total cross sections for He* (2 ^{3}S) + Ar and He* (2 ^{1}S) + Ar were calculated from 10^{-3} to 10^4 eV and compared with experimental data. The classical calculations used interaction potentials that agreed with ab initio theoretical calculations for the repulsive wall, possessed the correct long-range energy dependence, and were in agreement with glory-scattering experiments. The coupling width was an exponential with its free parameter determined by the thermal-energy ionization cross section for each system. The calculations were then extended over a wide range of energies. It was found that as the collision energy increased at the very low energies, the cross sections decreased until about 0.1 eV where they began slowly to rise. As the collision energy is further increased, the cross sections reach a maximum of about 15 Å^2 around 10 eV, and then decrease again at higher energies. The cross sections predicted by the high-energy results, 100 to 1500 eV, are compared with the data of Moseley, Peterson, Lorents, and Hollstein (Phys. Rev. A, 6: 1025-31(1972)) and are found to agree within 20% and to have a similar energy dependence. (auth)

46396 OPTICAL EXCITATION AND POLARIZATION IN LOW-ENRGY COLLISIONS OF $He^+ + H_2$. Isler, R. C.; Nathan, R. D. (Univ. of Florida, Gainesville). Phys. Rev., A; 6: No. 3, 1036-48(Sep 1972).

Optical studies of spectral lines produced in collisions of $He^+ + H_2$ were made at energies below 700 eV. Lines of atomic hydrogen and helium are the only features observed. Emission cross sections were measured for Lyman-β, Balmer-α, Balmer-β, and for the following He I lines: 5876 Å (3 ^{3}D → 2 ^{3}P), 6678 Å (3 ^{1}D → 2 ^{1}P), 4471 Å (4 ^{3}D → 2 ^{3}P). Emission cross sections are also listed at certain selected energies for all spectral lines observed. Polarization measurements were performed on the Balmer-α, the Balmer-β, and the visible helium lines. Only the Balmer-α line exhibits significant polarization, and the results are interpreted as indicating that the excited hydrogen atoms dissociate primarily in a direction perpendicular to the ion beam. (auth)

46397 ANGULAR DISTRIBUTION OF METASTABLE HYDROGEN FORMED BY ELECTRON CAPTURE IN A HELIUM TARGET. Fitzwilson, R. L.; Thomas, E. W. (Georgia Inst. of Tech., Atlanta). Phys. Rev., A; 6: No. 3, 1054-63(Sep 1972).

A study was made of the angular distribution of scattered particles induced by proton impact on a target of helium. Cross sections are presented for scattering of protons, of neutral hydrogen atoms, and of metastable hydrogen atoms. Impact energies range from 4 to 20 keV; scattering angles are from 0° to 2.0°. Measurements of the fractional metastable content of the scattered neutral flux rise from 1% or less at 0° to as much as 8% at angles of 1°. Theoretical predictions of the cross sections for scattering of all particles, neutrals and protons, show reasonable agreement with experiments. Theoretical predictions, by Colegrave and Stevens, of the probability for forming a neutral atom disagree with the experimental values by a constant phase factor. Measurements of the probability for forming a metastable atom do not agree with available theoretical predictions. (auth)

46398 CROSS SECTIONS FOR SINGLE-ELECTRON CAPTURE IN COLLISIONS OF PROTONS AND DEUTERONS WITH ATOMS. Tripathi, D. N.; Rai, D. K. (Banaras Hindu Univ., India). Phys. Rev., A; 6: No. 3, 1063-9(Sep 1972).

Electron-capture cross sections by protons (into 1s, 2s, and 3s

states) resulting from collisions with atomic systems were calculated using the simple classical formula of Gryzinski. Results obtained are compared with other theoretical calculations and experimental results. Comparison is made between the capture and ionization cross sections from collisions of heavy singly charged particles with atoms. (auth)

46399 DIFFERENTIAL- AND TOTAL-CROSS-SECTION CALCULATIONS FOR MODELS OF e–H_2 COLLISIONS. Sams, W. Neal (Univ. of Houston, Tex.); Frommhold, Lothar; Kouri, Donald J. Phys. Rev., A; 6: No. 3, 1070-6(Sep 1972).

Differential and total cross sections for e–H_2 collisions were calculated by the close-coupling procedure using three different model interaction potentials. Particular attention is focused on the simplest possible model having the desired physical properties. This model uses square wells to describe short-range interactions and the known polarization and quadrupole interactions for long-range potentials. The results obtained for this square-well model for e–H_2 collisions are very encouraging considering its simplicity. Comparisons with results obtained using other model potentials are presented. (auth)

46400 METHOD OF EFFECTIVE POTENTIALS: SCATTERING OF POSITRONS AND ELECTRONS BY LIGHT ATOMS. Monaghan, William (New York Univ., N. Y. Staten Island Community Coll., New York); Rosenberg, Leonard Phys. Rev., A; 6: No. 3, 1076-86(Sep 1972).

The theory of effective potentials is developed in a way that lends itself to variational formulations. The positron–helium and electron–helium systems are chosen to illustrate the method. The effective potential is defined in terms of the resolvent operator for a system modified by removal of the open-channel states. Rigorous maximum and minimum principles are derived, which should be useful in the computation of the effective potential and which are valid, for sufficiently low energies, even when the target bound-state wave function is not known exactly. A numerical application of this method to positron–hydrogen scattering has been made and results are reported. The effective-potential approach to the scattering problem leads naturally to a model for resonance calculations. This model is reviewed here and formulated variationally. An Appendix is devoted to further elaboration of this approach to resonance calculations in the context of potential scattering, with the aid of Jost-function theory. (auth)

46401 FERMI PRESSURE SHIFT AND ELECTRON–RARE-GAS-ATOM SCATTERING LENGTHS. Madan, Rabinder N. (North Carolina Agricultural and Technical State Univ., Greenboro). Phys. Rev., A; 6: No. 3, 1242-4(Sep 1972).

The treatment of the Fermi shift for alkali metals in the paper by M. H. Choudhury (Phys. Rev. 186, 66 (1969)) is examined. Some difficulties are pointed out, which render Choudhury's results to be of doubtful value. It is seen that starting from Choudhury's Hamiltonian one may recover an equation considered earlier by Mittleman for studying the Fermi-shift phenomenon. Finally, the Mittleman result is employed to make new estimates for the electron–neutral-atom scattering lengths. (auth)

46402 INTERPOLATION OF VARIATIONALLY OBTAINED SCATTERING CROSS SECTIONS. Heller, Eric J. (Harvard Univ., Cambridge, Mass.). Phys. Rev., A; 6: No. 3, 1247-8 (Sep 1972).

Standard variational methods are shown to contain the information necessary to construct the Jost function, a quantity previously shown to yield readily to interpolation. This allows narrow resonances to be found and characterized without extensive explicit computations. (auth)

46403 EXCITATION OF HYDROGEN IN COLLISIONS WITH ALKALI-METAL ATOMS. Mathur, K. C.; Tripathi, A. N.; Joshi, S. K. (Univ. of Roorkee, India). Phys. Rev., A; 6: No. 3, 1248-52(Sep 1972).

Excitation of hydrogen atoms from the ground state to 2s, 2p, 3s, 3p, and 3d states in passing through alkali metal atoms was studied using the Born approximation. The form-factor description of the target and the generalized-oscillator-strength representation of the projectile were used. (auth)

46404 CHEMI-IONIZATION IN COLLISIONS BETWEEN HELIUM METASTABLE ATOMS AND ARGON. Howard, J. S.; Riola, J. P.; Rundel, R. D.; Stebbings, R. F. (Rice Univ., Houston, Tex.). Phys. Rev. Lett.; 29: No. 6, 321-4(7 Aug 1972).

Cross sections for chemi-ionization in thermal energy collisions of He(2^1S) and He(2^3S) metastable atoms with argon were measured using both crossed-beam and gas-cell techniques. The results indicate that several earlier measurements of these cross sections were in error. (auth)

46405 OBSERVATION OF A BROAD RESONANCE IN THE 2^3S EXCITATION OF HELIUM BY ELECTRON IMPACT. Crooks, G. B.; DuBois, R. D.; Golden, D. E.; Rudd, M. E. (Univ. of Nebraska, Lincoln). Phys. Rev. Lett.; 29: No. 6, 327-9(7 Aug 1972).

A broad P-wave resonance was observed at about 50 eV primary energy in the angular distribution of electrons scattered after excitation of the 2^3S state of helium. The resonance has a width of about 15 eV and affects the differential excitation cross section by more than 3 orders of magnitude. It is suggested that this resonance is associated with the temporary formation of triply excited states of the negative helium ion. (auth)

46406 SCATTERING OF CsF BY ELECTRONS. Slater, Richard C.; Fickes, Michael G.; Stern, Richard C. (Columbia Univ., New York). Phys. Rev. Lett.; 29: No. 6, 333-6(7 Aug 1972).

Absolute differential and total cross sections for the scattering of CsF by 0.6- to 6.5-eV electrons were measured using the molecular-beam recoil technique. The first-Born-approximation differential cross section is used as the theoretical model to fit the data. The experimental differential cross sections rise more sharply near 0° than predicted. Total cross sections derived from these measurements are a factor of 1.5 to 4 smaller than the first-approximation results. (auth)

46407 MANIFESTATION OF STRUCTURE IN ELECTRON ENERGY DISTRIBUTION FUNCTIONS AND DETERMINATION OF THE EFFECTIVE CROSS SECTIONS OF INELASTIC PROCESSES. Soldatov, A. N.; Prilezhaeva, N. A. (Tomsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 51-62 (1971). (In Russian).

Features of the energy distribution function for electrons in a discharge with two tubular coaxially oriented electrodes were experimentally investigated. Effective cross sections of inelastic collisions were determined using the structure in the distribution functions of electrons, this structure having appeared as a result of inelastic processes. The time of energy recoil by electrons in "elastic" and "inelastic" energy regions was examined. The effective cross section of de-excitation of the metastable $He_2{}^3S_1$ was determined during collisions of the second kind with slow electrons, and the cross section of two metastable $He_2{}^3S_1$, the result of which was the production of an ionized molecule of helium He_2^+ and an electron with an energy of 15 eV. Reasons for the manifestation of structure in the electron energy distribution functions are discussed. (tr-auth)

Atomic Theory

46408 STATISTICAL CONSIDERATION OF RETARDATION IN RELATIVISTIC HARTREE–FOCK EQUATIONS. Gurchumeliya, A. D. (Georgian Polytechnic Inst., Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 67: No. 1, 53-6(Jul 1972). (In Russian).

A statistical calculation of exchange energy is presented, in which retardation appears when the atom is described in relativistic terms by the Hartree–Fock method. The contribution of retardation to the Hartree–Fock potential was found to equal $(\pi/2)$ $\alpha^2\rho$, which leads to correlations of the order of $\alpha^2 z^3$ for energy-term values of atoms. The ultrarelativistic limit is also considered. (auth)

46409 CORRELATION EFFECTS IN ATOMIC SYSTEMS. Larsson, Sven. Abstracts of Uppsala Dissertations from the Faculty of Science, No. 215. Uppsala; University of Uppsala (1972). 14p.

Thesis.

Eleven previously published papers on which a dissertation is based are summarized in three groups. The first group deals with calculations of wave functions for three-electron systems, the second with examination of correlation corrections to hyperfine structure expectation values, and the third with calculations of correlation corrections to the orbitals and a discussion of exchange and correlation potentials. (A.G.W.)

46410 INFINITE ORDER PERTURBATION THEORY WITH APPLICATIONS TO ATOMIC AND MOLECULAR SYSTEMS. Braendas, Erkki. Abstracts of Uppsala Dissertations from the Faculty of Science, No. 201. Uppsala; University of Uppsala (1972). 13p.

Thesis.

A dissertation based on seventeen previously published papers

is summarized. In the thesis, it is shown that substantial improvements in theory and computations of atomic and molecular properties and structure are obtained by incorporating the most attractive features of the variational and perturbation method into a unified theory. Inner projections and Pade approximants are used to demonstrate the merits of such a combination. (A.G.W.)

46411 THEORY OF COOPERATIVE EMISSION FROM TWO-LEVEL ATOMS. Rehler, Nicholas E. Rochester, N. Y.; Univ. of Rochester (1972). 153p. University Microfilms Order No. 72-18,832.

Thesis.

A new approach to the problem of cooperative emission from two-level atoms excited by a short plane-wave pulse is introduced. The treatment applies to an arbitrary number of atoms confined to a region with linear dimensions that may be large compared with λ, the wavelength associated with the atomic transition frequency. Explicit expressions are found, which describe the time evolution and directional character of the radiated power. The normally ordered relative intensity fluctuation is calculated for both the field radiated into any direction by a system with linear dimensions $\ll\lambda$ and the field radiated into the forward direction by a larger system. Large fluctuations when the system is nearly inverted indicate the discrete nature of spontaneous emission; the very small fluctuations found when only half of the atoms are excited show that the emission is then nearly classical. The far-field radiation patterns appropriate to the cases of a random distribution of atoms within a sphere and a right circular cylinder are considered in detail. Polar plots are presented of the radiation patterns produced when the atoms in a cylinder are excited by plane-wave pulses traveling both parallel and at an angle of 10° with the cylinder axis. All results are compared with related work by other authors. (Diss. Abstr. Int., B)

46412 PAIR CORRELATION ENERGIES AS DERIVED FROM THE ANALYSIS OF SEMI-EMPIRICAL VALUES OF CORRELATION ENERGIES OF ATOMS. Anno, Tosinobu; Sakai, Yoshiko (Kyushu Univ., Fukuoka). J. Chem. Phys.; 57: No. 4, 1636-47(15 Aug 1972).

For the purpose of obtaining the semiempirical formulas for the pair correlation energy of various types of atoms and ions having the electron configurations $1s^2 2s^m 2p^n (m = 0, 1, 2; n = 0, 1, \cdots, 6)$, semiempirical values of the correlation energies of such atoms are analyzed. It is pointed out that the correlation energy in the average of a configuration is more convenient than the correlation energy in each of the stationary states belonging to the configuration, for the purpose of this analysis. The correlation energy in the average of the configuration is shown to be equal to E_{Av}^{corr}, the average of the correlation energy in various states belonging to the configuration. The E_{Av}^{corr} values are obtained for a wide variety of the $1s^2 2s^m 2p^n$ atoms and regularities are found among these E_{Av}^{corr} values. From the analysis of these regularities, it is found that the E_{Av}^{corr} values of the $1s^2 2s^m 2p^n$ atoms can be reproduced very well with an equation $E_{Av}^{corr} = C_1 + C_2 m + C_3 n + C_4 m^2 + C_5 mn + C_6 n^2 + C_7 m^2 n + C_8 mn^2 + C_9 m^2 n^2 + C_{10} m(m-1)\, Z + C_{11} m(m-1)\, nZ + C_{12} m(m-1)\, Z^2$, where Z is the atomic number, along with the numerical values of the coefficients C_i's (i = 1, 2, ···, 12) determined from a least-squares fitting of this equation to various empirical E_{Av}^{corr} values. The concept of the average pair correlation energy of the configuration ϵ_{kl} is also proposed. Expressions for ϵ_{kl}'s are given in terms of the pair correlation energies of various type in each of the states belonging to the configuration. It is shown that E_{Av}^{corr} can be expressed in a simple form in terms of ϵ_{kl}'s. From this expression and the semiempirical expression of E_{Av}^{corr} mentioned above, a semiempirical formula for the average pair correlation energy is obtained for each type of electron pairs. It is found that these semiempirical formulas are in accord with the results of the Sinanoğlu theory for the ground and the excited states and of nonempirical calculations of pair correlation energies, rather than with those of a previous purely empirical analysis of the correlation energies by Allen, Clementi, and Gladney. (auth)

46413 UPPER AND LOWER BOUNDS TO EXCITED STATES OF TWO-ELECTRON ATOMS. Wang, P. S. C.; Weinhold, F. (Stanford Univ., Calif.). J. Chem. Phys.; 57: No. 4, 1738-45 (15 Aug 1972).

The excited $^{1,3}S$ and $^{1,3}P$ states of the helium isoelectronic sequence are treated by the Ritz and Bazley variational methods, which together provide rigorous upper and lower bounds to the true nonrelativistic energy levels. With compact variational functions constructed from about 25 hydrogenic basis terms, up to 20 or more states of each symmetry can be treated for each ion. The error limits finally approach a few parts in 10^5 or better for many of the more highly excited states (including many not yet observed), an accuracy sufficient to determine the ionization potentials to about 1%. (auth)

46414 NATURE OF TWO-PARTICLE CORRELATIONS IN ATOMS. Geller, Elane N.; Geller, Murray (California Inst. of Tech., Pasadena). J. Chem. Phys.; 57: No. 4, 1814(15 Aug 1972).

A method for analytical evaluation of radial integrals used by Ruffa (J. Chem. Phys., 52: 1512(1970)) in discussion of the nature of two-particle correlations in atoms is suggested briefly. (A.G.W.)

46415 VARIATIONAL BOUNDS FOR IMAGINARY FREQUENCY POLARIZABILITY AND DISPERSION INTERACTION CONSTANT. Braun, P. A.; Rebane, T. K. (Leningrad State Univ.). Int. J. Quant. Chem.; 6: No. 4, 639-46(Jul 1972).

A study is made of a variational principle that provides upper and lower bounds for the polarizability under a perturbation with imaginary frequency. As an example bounds for the imaginary frequency polarizability of atomic hydrogen and ensuing limits for the constant of van der Waals interaction of two hydrogen atoms are calculated. (auth)

46416 DECOUPLED HARTREE–FOCK METHODS. I. CALCULATIONS FOR ATOMS WITH ORTHOGONALIZED ORBITALS. Naray-Szabo, G. (Technical Sciences Univ., Budapest). Int. J. Quant. Chem.; 6: No. 4, 779-85(Jul 1972).

By a proper approximation of the interaction term in a many-electron Hamiltonian the Hartree–Fock (HF) equations are decoupled. Making use of this simplification one obtains a good initial guess for the wave function with minimal computational work. Refining the procedure, the exact HF limit can be achieved. Total energies, ionization potentials and excitation energies for light atoms are calculated. (auth)

46417 VARIATIONAL PRINCIPLES FOR SINGLE-PARTICLE EXPECTATION VALUES IN THE HARTREE APPROXIMATION. Krieger, J. B. (Brooklyn Coll.). Phys. Rev., A; 6: No. 3, 919-27(Sep 1972).

The application of Delves's variational principle for the calculation of the expectation value of single-particle operators W is investigated in the Hartree approximation. In this approximation the auxiliary function is taken to be of the form $\psi_{1T} = \Sigma_i f_i(\vec{r}_i)\psi_{0T}$, where ψ_{0T} is the trial ground-state wave function. For a given ψ_{0T}, a set of coupled integrodifferential equations satisfied by the $f_i(\vec{r}_i)$ is derived by minimizing an auxiliary functional containing ψ_{0T}, ψ_{1T}, W, and the Hamiltonian of the system. The resulting equations are uncoupled in two different approximations each valid for one- and two-particle systems and are compared to those employed by others and to those previously suggested by the authors on the basis of certain self-consistency considerations. The uncoupled equations are solved exactly for single-particle operators that depend on the radial distance only. The utility of the technique is demonstrated by showing that for a model hydrogen-atom problem it leads to highly accurate results for the electron density at the origin and the Fourier transform of the electron density even when the calculation of these quantities employing ψ_{0T} alone is substantially in error. The results of applying the technique to the helium atom for the calculation of $\langle \gamma^n \rangle$, n = –2, –1, 1, 2, and the electron density at the origin employing an energy-minimized product of hydrogenic wave functions for ψ_{0T} are reviewed and compared with those of Pekeris and found to have an accuracy equivalent to a numerical Hartree–Fock calculation. Finally, the decoupling approximations are extended to systems containing more than two particles. (auth)

46418 APPLICATION OF GREEN'S FUNCTIONS TO RADIATIVE COOPERATIVE EFFECTS IN MULTI-ATOM SYSTEMS. Duncan, G. Comer (Bowling Green State Univ., Ohio). Phys. Rev., A; 6: No. 3, 947-58(Sep 1972).

Spontaneous-radiation processes associated with a number of multi-atom systems are studied. Green's-function techniques are used in conjunction with a model of N two-level atoms interacting with a quantized radiation field to investigate the assumption of the independence of the spontaneous-radiation properties of a given atom from the states of the other atoms in the system. It is shown that the natural linewidth of an excited atom in the presence of a de-excited atom is different from that of an isolated excited atom. For interatomic separations smaller than a critical separation, the two-atom system is best considered as a collective unit with regard to its spontaneous-radiation properties. The influence of these "radiative cooperative effects" is studied also for the systems of two initially excited atoms. Also the influence of radiative cooperative effects in the scattering of a photon by a system of two de-excited atoms is studied. It is shown that the frequency distribution of the scattered radiation exhibits a double-peak structure for interatomic separations smaller than $\frac{3}{4}\lambda$. The techniques of Green's functions are then applied to the study of radiative cooperative effects in several many-atom systems. It

is shown that within the context of the model certain information is obtained exactly via the Green's-function techniques as applied to the many-atom problems of a single excited atom in the presence of $N \gg 1$ de-excited atoms and the scattering of a photon by a system of $N \gg 1$ de-excited atoms. The necessity of treating many-atom systems from a "collective" point of view is easily seen from our results. (auth)

46419 COUPLED MULTICONFIGURATIONAL SELF-CONSISTENT-FIELD METHOD FOR ATOMIC DIPOLE POLARIZABILITIES. I. THEORY AND APPLICATION TO CARBON. Billingsley II, Frank P.; Krauss, Morris (National Bureau of Standards, Washington, D. C.). Phys. Rev., A; 6: No. 3, 855-65(Sep 1972).

A method for calculating static dipole polarizabilities of atoms within a multiconfigurational self-consistent-field (SCF) framework is presented. The method involves the direct solution of the multiconfigurational SCF equations of an atom in the presence of a perturbing field simulated by a charged particle. The use of a multiconfigurational framework allows this technique to be applied straightforwardly to any given state of both degenerate and nondegenerate atoms, and also allows the explicit introduction of correlation effects. Sample calculations are reported for the static dipole polarizabilities of the carbon atom in its ^1S, ^1D, and ^3P states with partial inclusion of correlation. The results are compared with those obtained from many-body perturbation theory and other techniques. In addition, a prescription for specifying a sufficiently flexible set of polarization basis functions is described. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

46420 WEAK FLUCTUATION MODES OF AN ELECTRICALLY AND THERMALLY CONDUCTING VISCOUS COMPRESSIBLE FLOW IN A HOMOGENEOUS MAGNETIC FIELD. Stanisic, Milomir M. (Purdue Univ., Lafayette, Ind.). Z. Angew. Math. Phys.; 22: No. 6, 1088-94(25 Nov 1971).

The propagation of small disturbances in a three-dimensional unsteady, viscous, compressible fluid with finite conductivity is considered in detail, so that earlier results appear as special limiting cases. It is noted that although the flow is not isentropic in the strict sense, the entropy change appears only as second order effect both in the pressure and in the magnetic field. It is concluded that, in the case of compressible, electrically and thermally conducting viscous flow with finite conductivity there is no corresponding group and phase velocity associated with given wave number resulting from finite conductivity. (M.H.R.)

46421 VORTICITY JUMP ACROSS A STATIONARY MAGNETOGASDYNAMIC DISCONTINUITY. Sharma, V. D.; Ram, Rishi (Banaras Hindu Univ., India). Z. Angew. Math. Phys.: 22: No. 6, 1126-34(25 Nov 1971).

The Hayes [J. Fluid Mech. 2, 595(1957)] analysis is generalized to an MHD discontinuity and it is shown that the vorticity jump across a magnetogasdynamic discontinuity is not derivable from the momentum equation alone but would also essentially require the use of the energy equation except in some particular cases of MHD flows. (M.H.R.)

46422 SECONDARY FLOW OF A CONDUCTING FLUID IN A ROTATING STRAIGHT ANNULAR PIPE. Rao, V. V. Ramana (Andhra Univ., Waltair, India). Proc. Indian Acad. Sci., Sect. A; 75: No. 4, 189-98(Apr 1972).

A theoretical analysis is made of the flow of a conducting viscous and incompressible fluid through a straight annular pipe of circular cross section flowing under a constant pressure gradient. The pipe is rotated about an axis perpendicular to it and also there is imposed a uniform magnetic field transverse to the motion. The secondary flow pattern was studied in detail for small values of angular velocity and Hartmann number. (auth)

46423 MAGNETOHYDRODYNAMIC ENTRANCE FLOW IN A CHANNEL. Flores, F.; Recuero, A. (Univ. of Madrid). Appl. Sci. Res. (The Hague); 25: No. 6, 403-12(Mar 1972).

An MHD entrance flow in a channel is studied in the Prandtl approximation. It is shown that consistency with the approximation requires an appropriate change in the boundary conditions that hold for the original, unsimplified equations. The correct boundary conditions are established and used to repeat the numerical calculations in a few cases studied by other authors with the unmodified boundary conditions. In the cases considered here, the numerical differences do not amount in practice to more than 10%, although they grow with increasing Hartmann number. (auth)

46424 MOTION OF A SPHERE IN AN ELECTRICALLY CONDUCTING ROTATING FLUID. Sarma, L. V. K. V.; Seetharamaswamy, R. (Indian Inst. of Tech., Madras). Appl. Sci. Res. (The Hague); 25: No. 6, 431-44(Mar 1972).

The combined effect of rotation and magnetic field is investigated for the axisymmetric flow due to the motion of a sphere in an inviscid, incompressible electrically conducting fluid having uniform rotation far upstream. The steady-state linearized equations contain a single parameter $\alpha = \frac{1}{2}\beta R_m$, β being the magnetic pressure number and R_m the magnetic Reynolds number. The complete solution for the flow field and magnetic field is obtained, and the distribution of vorticity and current density is found. The induced vorticity is $O(\alpha^4)$ and the current density is $O(R_m)$ on the sphere. (auth)

46425 TWO-DIMENSIONAL NONSTEADY-STATE SOLUTION OF MAGNETOHYDRODYNAMIC EQUATIONS. Imshennik, V. C. Zh. Prikl. Mekh. Tekh. Fiz.; No. 2, 3-7(1972). (In Russian).

A solution to MHD equations by A. G. Kulikovskii (1958) supports the case of a plane, cumulation of matter in the vicinity of a null line of a magnetic field, which may be related to certain plasma processes (z-pinch, solar flares). A certain class of simple solutions to MHD equations for a two-dimensional plane, nonsteady-state motion was examined. Two subclasses of solutions with completely different physical significance were found, and of fundamental interest is that subclass which comprises the solution for a cumulative plane compression of matter in the environment of the null line of a magnetic field. (K.S.W.)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstract: 46126.

Electromagnetic

Refer also to abstract: 46733.

46426 (BNL-16968) PHOTOPRODUCTION EXPERIMENTS AT ISABELLE. Drickey, D. J. (Brookhaven National Lab., Upton, N. Y.). 16 Jun 1972. 7p. Dep. NTIS.

Trivial extensions are made to the ISABELLE e−p parameters of 5-GeV electrons on 200-GeV protons. The electroproduction total cross section as a function of equivalent laboratory photon energy is shown. It is concluded that photoproduction experiments in a new energy range are possible with the ISABELLE e−p option even for Compton scattering processes provided care is taken in the design of the interaction region. (J.F.P.)

46427 (CONF-710816-13) $\pi^+\pi^-\pi^0$ PRODUCTION BY e^+e^- ANNIHILATION AT THE ω MASS. Benaksas, D.; Cosme, G.; Jean-Marie, B.; Jullian, S.; Laplanche, F.; Lefrancois, J.; Liberman, A. D.; Parrour, G.; Repellin, J. P.; Sauvage, G. (Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire). [nd]. 12p. Dep. NTIS (U. S. Sales Only).

From International symposium on electron and photon interactions at high energies; Ithaca, N. Y. (23 Aug 1971).

Cross sections for $e^+ + e^- \rightarrow \pi^+ + \pi^- + \pi^0$ annihilation in the Orsay storage ring, the ω width, and the width and branching ratio for $\omega \rightarrow e^+ + e^-$ decay are found using a large solid angle detector. The experimental set-up is described. (J.F.P.)

46428 (CONF-710816-14) $\pi^+\pi^-$ PRODUCTION BY e^+e^- ANNIHILATION IN THE ρ ENERGY RANGE WITH THE ORSAY STORAGE RING. Benaksas, D.; Cosme, G.; Jean-Marie, B.; Jullian, S.; Laplanche, F.; Lefrancois, J.; Liberman, A. D.; Parrour, G.; Repellin, J. P.; Sauvage, G. (Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire). 1971. 16p. Dep. NTIS (U. S. Sales Only).

From International symposium on electron and photon interactions at high energies; Ithaca, N. Y. (23 Aug 1971).

A large solid angle detector was used to observe two body events produced by electron-positron collisions in the Orsay storage ring. From the $\pi^+\pi^-$ excitation curve in the ρ region the amplitude and the phase of the $\omega-\rho$ interference, and the ρ resonance parameters were deduced. (auth)

46429 (CONF-710816-15) HADRONIC PRODUCTION BY e^+e^- COLLISIONS AT 990 MeV WITH THE ORSAY STORAGE RING. Benaksas, D.; Cosme, G.; Jean-Marie, B.; (and others) (Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire). 1971. 8p. Dep. NTIS (U. S. Sales Only).

From International symposium on electron and photon interactions at high energies; Ithaca, N. Y. (23 Aug 1971).

A large solid angle detector is used to measure the cross sections for $e^+ + e^- \rightarrow \pi^+ + \pi^- + \pi^0(2\pi^0)$ interactions at 990 MeV in colliding beams. Also an upper limit is found for $e^+ + e^- \rightarrow 2\pi^+ + 2\pi^-$ interactions. (J.F.P.)

46430 (COO-1195-241) MISSING-MASS SPECTRUM NEAR 960 MeV FROM $\pi^-p \rightarrow n +$ (mm). Holloway, L.; Huld, B.; Koetz, U.; (and others) (Illinois Univ., Urbana). Jun 1972. Contract AT(11-1)-1195. 7p. (CONF-720409-6). Dep. NTIS.

From third international conference on experimental meson spectroscopy; Philadelphia, PA. (28 Apr 1972).

Supporting evidence for structure near 960 MeV in the reaction $\pi^-p \rightarrow n +$ (missing-mass) at 2.5 GeV/c is presented. (auth)

46431 (NP-19256) SEPARATION OF σ_S AND σ_T IN THE REGION OF THE $\Delta(1236)$ RESONANCE AND DETERMINATION OF THE MAGNETIC DIPOLE TRANSITION FORM FACTOR. Baetzner, K.; Beck, U.; Becks, K. H.; (and others) (Bonn Univ. (West Germany). Physikalisches Institut). Feb 1972. 13p. (PIB-1-157). Dep. NTIS (U. S. Sales Only).

The longitudinal and transverse cross sections σ_S and σ_T are evaluated from measurements of inelastic ep scattering at scattering angles ranging from 20 to 81°. The magnetic dipole transition form factor G_M^* is determined and the reliability of the determination is discussed. (auth)

46432 (SLAC-Trans-142) PHOTOPRODUCTION OF NEUTRAL PIONS ON HELIUM NUCLEI. Tsarev, V. A.; Daion, M. I.; Rakov, Yu. A. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). Translated for Stanford Linear Accelerator Center, Calif., from Preprint No. 170. 27p. Dep. NTIS.

The physics and proposed measurements of the cross sections for $\gamma + {}^4He \rightarrow {}^4He + \pi^0$ interactions at 2 to 5 GeV and pion emission angles above 10° using a streamer chamber are discussed. The π^0 lifetime can also be determined from this reaction. (J.F.P.)

46433 SCALE RELATION FOR PROTON FORM FACTORS. Bilen'kaya, S. I.; Bilen'kii, S. M.; Kazarinov, Yu. M. (Joint Inst. for Nuclear Research, Dubna, USSR). JETP Lett. (USSR) (Engl. Transl.); 15: No. 7, 297-9(5 Apr 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 7, 420-3(5 Apr 1972).

The validity of the scale relation $G_M(q^2) = \mu G_E(q^2)$, where $G_E(q^2)$ and $G_M(q^2)$ are the charge and magnetic form factors of the proton and μ is the total magnetic moment of the proton in nuclear magnetons, was investigated through an analysis of all available data on e−p scattering cross sections. The electromagnetic form factors were extracted directly from the data by assuming a certain functional dependence of the form factors on q^2 and obtaining the values of the corresponding parameters by minimizing the functional χ^2. The experimental data of different groups were reduced by introducing normalization factors to take account of the possible errors in the normalization of the data. The analysis confirmed the validity of the scale relation within the appropriate errors. (R.W.R.)

46434 EXPERIMENTAL STUDY OF THE DECAYS $K_{S,L} \rightarrow \gamma\gamma$. Banner, M.; Coronin, J. W.; Hoffman, C. M.; Knapp, B. C.; Shochet, M. J. (Princeton Univ., N. J.). Phys. Rev. Lett.; 29: No. 4, 237-40(25 Jul 1972).

The branching ratio $(K_S \rightarrow \gamma\gamma)/(K_S \rightarrow \text{all})$ was measured to be $(-1.9 \pm 2.4) \times 10^{-4}$ in an optical spark-chamber experiment. The result assumes no interference between $K_S \rightarrow \gamma\gamma$ and $K_L \rightarrow \gamma\gamma$. In addition, the branching ratio $(K_L \rightarrow \gamma\gamma)/(K_L \rightarrow \text{all})$ was measured to be $(4.32 \pm 0.55) \times 10^{-4} \times |\eta_{00}/\eta_{+-}|^2$. (auth)

46435 FURTHER EVIDENCE FOR THE DECAY MODE $\phi \rightarrow \eta\gamma$ AND MEASUREMENT OF THE BRANCHING RATIO $\Gamma(\phi \rightarrow \eta\gamma)/\Gamma(\phi \rightarrow \text{total})$. Basile, M.; Dalpiaz, P.; Frabetti, P. L.; (and others) (CERN, Geneva. Univ., Bologna. Istituto Nazionale di Fisica Nucleare, Bologna. CNRS, Strasbourg). Nucl. Phys.; B44: No. 2, 605-17(1972).

The reaction $\pi^-p \rightarrow \eta\phi$ was studied at 1.8 GeV/c incident pion momentum using the Bologna-CERN NBC set-up, in order to investigate the electromagnetic decay mode $\phi \rightarrow \eta\gamma$. (27 ± 6) events were observed, yielding a branching ratio $\Gamma(\phi \rightarrow \eta\gamma)/\Gamma(\phi \rightarrow \text{total}) = (7.3 \pm 1.9)\%$. The theoretical implications of this result are discussed. (auth)

46436 POLARIZED PROTON AND DEUTERON TARGETS AND HIGH-ENERGY PHYSICS EXPERIMENTS. Borghini, M. (CERN, Geneva). pp 145-80 of High Energy Phenomenology. /Tran Thanh Van, J. (ed.). Paris; Laboratoire de Physique Theorique et Hautes Energies (1971).

From Conference of Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971). See CONF-710345-(Vol.2).

Progress in polarized targets to be used for high energy physics experiments (above a few GeV) is reviewed. This progress consists of improvements in the nature of the substances containing the polarized protons (alcohol targets), the polarization of deuterons, a better understanding of the effects producing the polarization, and the use of more elaborate equipment as far as target geometry is concerned. Recent results obtained using these targets in lepton scattering, photoproduction and hadron scattering are briefly surveyed. (France)

46437 DIFFRACTIVE FRAGMENTATION IN HIGH ENERGY PHOTON REACTIONS. Fries, D. (Univ., Karlsruhe, Ger.). pp 267-88 of High Energy Phenomenology. /Tran Thanh Van, J. (ed.). Paris; Laboratoire de Physique Theorique et Hautes Energies (1971).

From Conference of Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971). See CONF-710345-(Vol.2).

A multiprong photoproduction experiment was performed using an 18-GeV bremsstrahlung photon beam and a gaseous hydrogen target. Preliminary results from the analysis of film data are

presented. Experimental evidence was obtained between 4 and 18 GeV, for a ρ^0 signal having an energy dependence similar to that involved in diffractive elastic ρ photoproduction. A diffractive fragmentation of the isovector photon is shown to occur simultaneously with the fragmentation of the target. (France)

46438 TOPICS IN PHOTOPRODUCTION. Braccini, P. L. (Univ., Pisa, Italy). pp 527-49 of High Energy Phenomenology. /Tran Thanh Van, J. (ed.). Paris; Laboratoire de Physique Theorique et Hautes Energies (1971).

From Conference of Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971). See CONF-710345-(Vol.2).

The photoproduction reaction $\gamma + p \rightarrow \rho^0 + p$ was studied at 2.8 and 4.7 GeV. A t dependence of the mass distribution was observed and a dependence of the t distribution on the dipion mass was also found, the results being in agreement with a previous dual model. In the helicity system, for $-t < 0.4$ (GeV/c)^2, the density matrix has the same structure as the photon density matrix. Evidence for the validity of the Soeding model was obtained from the cross sections for ρ production. (France)

46439 REVIEW AND ANALYSIS OF THE LATEST DATA ON MEASURING FUNDAMENTAL PHYSICAL CONSTANTS (MAGNETIC MOMENTS OF AN ELECTRON, MUON, AND PROTON). Gorbatsevich, S. V.; Kholin, V. M.; Nosal, V. N. Meas. Tech. (USSR) (Engl. Transl.); 15: No. 1, 20-31(Jan 1972). Translated from Izmer. Tekh.; 15: No. 1, 14-20(Jan 1972).

This review and analysis of data covers the relation of the electron magnetic moment to the Bohr magneton, the relation of the magnetic moment of an electron and a proton, the ratio of the proton magnetic moment to the Bohr magneton, evaluation of the ratio of a muon magnetic moment to a muon magneton, and the ratio of the muon and proton magnetic moments. Also included are the ratio of the g-factors of a muon and electron, the ratio of the masses of a proton and an electron, and the ratio of the masses of a muon and an electron. (J.F.P.)

46440 MEASUREMENT OF THE MAGNETIC MOMENT OF THE ANTIPROTON. Fox, J. D. (Brookhaven National Lab., Upton, N. Y.); Barnes, P. D.; Eisenstein, R. A.; (and others). Phys. Rev. Lett.; 29: No. 3, 193-5(17 Jul 1972).

Fine-structure splittings in atoms formed by antiprotons with both lead and uranium were measured. Since the fine structure is produced by an interaction between the magnetic moment of the antiproton and the Coulomb field of the nucleus, a value for the magnetic moment can be derived from the observed splitting. A magnetic moment of -2.83 ± 0.10 nuclear magnetons is found which agrees with the TCP prediction. (auth)

46441 PHOTOPRODUCTION OF CHARGED PIONS BY NUCLEI AT E_0 = 1160 MeV. Grishaev, I. A.; Lapin, N. I.; Nikiforov, V. I.; Pugachev, G. D.; Shramenko, B. I. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 16: No. 9, 1550-2 (Sep 1971). (In Russian).

The yield of charged π-mesons formed by the nuclei C, Al, Cu, Ta, and Pb was measured during maximum energy of retarding gamma-quanta at E_0 = 1160 MeV at an angle of 150°. The kinetic energy of the pions was 40 and 65 MeV. Detection of pions was accomplished using photoemulsion. The total yield of charged mesons was proportional to $A^{0.71}$. (tr-auth)

46442 ASYMMETRY MEASUREMENTS FOR π^0 AND π^+ PHOTOPRODUCTION BY LINEARLY POLARIZED γ-RAYS IN THE ENERGY RANGE (400 TO 900) MeV. Zdarko, R. W. (Stanford Univ., Calif.); Dally, E. B. Nuovo Cim.; 10A: No. 1, 10-18(1 Jul 1972).

The asymmetry ratio $A = (\sigma_\perp - \sigma_{||})/(\sigma_\perp + \sigma_{||})$ was measured by means of linearly polarized γ-rays for π^0 and π^+ photoproduction. For the reaction $\gamma + p \rightarrow n + \pi^+$, measurements were taken for $\theta_{c.m.} = 135°$ at γ-ray energies ranging from 390 to 909 MeV. For the reaction $\gamma + p \rightarrow p + \pi^0$, measurements were taken for $\theta_{c.m.} = 60°$ and 90° at γ-ray energies ranging from 426 to 918 MeV. (auth)

46443 ϕ-MESON MASS DETERMINATION. Balakin, V. E.; Bukin, A. D.; Pakhtusova, E. V.; Sidorov, V. A.; Khabakhpashev, A. G. (Inst. of Nuclear Physics, Novosibirsk, USSR). Phys. Lett.; 40B: No. 3, 431-2(10 Jul 1972).

Calibration of the electron-positron storage ring energy using the angular distribution of pions produced in the reaction $e^+e^- \rightarrow \phi \rightarrow K_L^0 K_S^0 \rightarrow \pi^+\pi^-$ allowed the ϕ-meson mass to be determined: $M_\phi = 1020.8 \pm 0.8$ MeV. (auth)

46444 ASYMMETRY FOR π^+ PHOTOPRODUCTION FROM POLARIZED PROTONS BETWEEN 300 AND 900 MeV AT 90°. Arai, S. (Nagoya Univ., Japan); Fukui, S.; Horikawa, N.; (and others). Phys. Lett.; 40B: No. 3, 426-30(10 Jul 1972).

The asymmetry of the cross section for π^+ photoproduction from a polarized butanol target was measured at a c.m. angle 90° and photon energies between 300 MeV and 900 MeV by detecting only positive pions. (auth)

46445 COHERENT PHOTOPRODUCTION OF ρ MESONS FROM DEUTERIUM. Overman, Irving Dean. Stanford, Calif.; Stanford Univ. (1972). 81p. University Microfilms Order No. 72-16,766.

Thesis.

Measurements of the forward differential cross section for the process $\gamma + d \rightarrow \rho^0 + d$ were made at Stanford Linear Accelerator Center. The bremsstrahlung photon beam was made by passing the SLAC high power electron beam into an aluminum or copper radiator. A condensation type liquid deuterium target was used for large momentum transfers and a high pressure gas target was used for small momentum transfers. The recoil deuterons were detected and analyzed in momentum and direction by the SLAC 1.6 GeV/c spectrometer using a time-of-flight technique. A rotatable "missing mass" hodoscope was placed in the focal plane of the spectrometer to determine the kinematics. Measurements were made at three energies: 6, 12, and 18 GeV and covered a momentum transfer range of $-0.15 > t > -1.4$ (GeV/c)^2. The results were interpreted on the basis of the Glauber high energy multiple diffraction model and found to be in excellent agreement. From this analysis values for both the total and differential cross section for the reaction $\rho^0 + N \rightarrow \rho^0 + N$ were extracted in rough agreement with the quark model. The value of σ_T obtained in this experiment was used together with previous hydrogen photoproduction data and with total photoabsorption cross section measurements to determine the $\gamma-\rho$ coupling constant in the vector dominance model. The results of these two calculations are in disagreement well outside experimental errors and indicate the vector dominance model does not describe all physical processes relating to photon-hadron interactions. (Diss. Abstr. Int., B)

46446 STUDY OF NON-STRANGE BOSON RESONANCES PRODUCED BY QUASI-MONOCHROMATIC PHOTON BEAMS OF ENERGIES BETWEEN 4.3 AND 7.5 GeV IN A HYDROGEN BUBBLE CHAMBER. Menke, Michael Matthew. Stanford, Calif.; Stanford Univ. (1972). 187p. University Microfilms Order No. 72-16,755.

Thesis.

The photoproduction of resonances was studied in three exposures of a hydrogen bubble chamber to positron annihilation radiation of 4.3, 5.25 and 7.5 GeV nominal energies. The general analysis procedure and results on the three-prong event topology are presented. The highly constrained reaction $\gamma p \rightarrow p\pi^+\pi^-$ over the energy range 2 to 8 GeV and the reactions $\gamma p \rightarrow p\pi^+\pi^-\pi^0$ and $\gamma p \rightarrow \pi^+\pi^+\pi^- n$ at the annihilation energies were studied. Cross sections are given. Using various models to parameterize ρ^0 photoproduction in $\gamma p \rightarrow p\pi^+\pi^-$, the mean t-slope found is 7.0 ± 0.4 GeV^{-2}, while the ρ^0 forward cross section decreases from about 130μb/GeV^2 at 3.3 GeV to about 100μb/GeV^2 at 7.5 GeV. The cross section for $\gamma p \rightarrow \omega p$ is decomposed into an OPE and a diffractive part, which is found to be 1.5 ± 0.3 μb. $(d\sigma(\rho)/dt)/d\sigma(\omega)/dt)|_{t=0}$ is then 9.4 ± 2.3 at 7.5 GeV. In comparing $d\sigma/dt$ for vector meson production with that of Compton scattering via VDM for photon energies above 4 GeV, it is found that for $\gamma_\rho^2/4\pi = 0.32 \pm 0.03$ there is good agreement at all s and t. This same $\gamma_\rho^2/4\pi$ relates the forward ρ^0 cross sections to $\sigma_T(\gamma p)$ at all our energies. A search for $\rho' \rightarrow 2\pi$ finds, at the 90% confidence level, $\sigma_{\rho'}(1250) < 0.3$ μb and $\sigma_{\rho'}(1650) < 0.1$ μb per 100 MeV width. Inelastic peripheral ρ^0 production is seen in both the proton and the neutron channels, but with present statistics specific nucleon isobars cannot be associated with it. The quasi-two body reactions $\gamma p \rightarrow \pi^-\Delta^{++}$, $\rho^-\Delta^{++}$, and $A_2^+ n$ are observed, with cross sections decreasing with photon energy like E_γ^{-a}. For the first two $a = 1.74 \pm 0.16$ and 0.6 ± 0.2 respectively, indicating that they are unlikely to have the same production mechanism. It follows that if the reaction $\gamma p \rightarrow \rho^-\Delta^{++}$ is due to an OPE process, the required rho radiative decay width (~0.5 MeV) is much in excess of the value predicted by SU(3). (Diss. Abstr. Int., B)

46447 PI-ZERO PHOTOPRODUCTION FROM COMPLEX NUCLEI. Meyer, Walter Thomas. Ithaca, N. Y.; Cornell Univ. (1971). 139p. University Microfilms Order No. 72-15,424.

Thesis.

One of the consequences of the vector meson dominance theory for photon interactions is that at high energies a photon incident on a nucleus has its ability to interact inhibited by the interference from a wave of photoproduced vector mesons. The result of this interference is that at low energies, less than about 2 GeV, one would expect the interactions to occur over the entire volume of the nucleus, and that at high energies, above about 8 GeV, they

would occur only near the surface. It is convenient to refer to the nucleus in terms of the effective number of nucleons, Z_{eff}, N_{eff}, or A_{eff}, taking part in the interaction. Thus, excluding final state absorption, A_{eff}, for example, would be expected to vary as the nucleon number A at low energies and as $A^{\frac{1}{3}}$ at high energies. The transition between these two limits is investigated. The process measured was $\gamma + A \rightarrow \pi^0 + A$ where the energies and positions of the two decay photons from the pi-zero were measured. The photon detectors consisted of two arrays, each consisting of 28 lead glass total absorption counters $1\frac{3}{4}$ inches × $1\frac{3}{4}$ inches × 15 inches deep. By looking at the shower spread between adjacent counters we get spatial information of the photon and by summing the pulses from these cells we get energy information. At the highest energies the energy resolution was 15 percent fwhm and the spatial resolution was about 0.5 fwhm. A_{eff} was measured for beryllium, carbon, aluminum, copper, silver, and lead at mean photon energies of 3.5, 4.4, 6.3, 8.3 GeV. The range in four momentum transfer was $.1 < -t < .25$ $(GeV/c)^2$. Contrary to theoretical expectations no significant transition with energy is seen. The cause of this disagreement is not yet known. (Diss. Abstr. Int., B)

Weak

46448 (LBL–791) RANGE–MOMENTUM CORRELATION IN CARBON AND IRON FOR MUONS OF 500 TO 1500 MeV/c. Field, R. Clive (California Univ., Berkeley. Lawrence Berkeley Lab.). 14 Apr 1972. Contract W-7405-eng-48. 25p. Dep. NTIS.

The range and straggling of positive and negative muons in a stopping medium composed principally of lead, graphite, and steel were investigated experimentally with data from a Bevatron spectrometer. It is concluded that the Bethe–Bloch formula is capable of representing the range behavior of muons between 500 MeV/c and 1500 MeV/c within ±0.3%. Values of the mean excitation energies of 79 ± 7 eV for graphite and 287 ± 13 eV for iron are obtained. (auth)

46449 (SLAC-Trans-143) K_2^0 DECAY IN A WILSON CHAMBER. Astier, A.; Blaskovic, L.; DeCourreges, M. M.; Equer, B.; Lloret, A.; Rivet, P.; Slaud, J. Translated for Stanford Linear Accelerator Center, Calif., from pp 227-34 of report NP–11592 (Vol.1). 10p. (CONF-610904–1). Dep. NTIS.

From Conference on elementary particles; Aix-en-Provence, France (14 Sep 1961).

A Wilson chamber was used to determine the branching ratios for the decays $K_2^0 \rightarrow 3\pi^0$, $K_2^0 \rightarrow \pi^+ + \pi^- + \pi^0$, $K_2^0 \rightarrow \pi^+(\pi^-) + e^-(e^+) + \nu$, and $K_2^0 \rightarrow \pi^+(\pi^-) + \mu^-(\mu^+) + \nu$. The mean K_2^0 lifetime was also found. (J.F.P.)

46450 INVESTIGATION OF LOW-q^2 INELASTIC NEUTRINO EVENTS. Masnou, J. L.; Six, J. (Laboratoire de l'Accelerateur Lineaire, Orsay, France). Nuovo Cim.; 10A: No. 1, 87-96 (1 Jul 1972).

Experimental results on low-q^2 inelastic neutrino interactions are presented and compared with the PCAC hypothesis. Agreement is found for $q^2 < 0.12$ $(GeV/c)^2$. Correction terms, coming from the transverse-current contributions, are estimated from a meson dominance model and are found to grow rapidly with q^2. The PCAC hypothesis with these correction terms is only valid experimentally for $q^2 < 0.2$ $(GeV/c)^2$. (auth)

46451 INELASTIC INTERACTION INDUCED BY HIGH-ENERGY MUONS (6 GeV, 12 GeV) AT LOW MOMENTUM-TRANSFER IN NUCLEAR EMULSION. Montret, J. C.; Coupat, B.; Michel, B.; Vazeille, F. (Univ., Clermont-Ferrand, France). Nuovo Cim.; 10A: No. 3, 490-8(1 Aug 1972).

Inelastic scattering of 6 and 12 GeV muons was studied in Ilford K5 nuclear emulsions. For energy transfers greater than 150 MeV (for π muoproduction threshold) and a four-momentum transfer smaller than 0.1 $(GeV/c)^2$, the cross sections are respectively (11.1 ± 1.4) μb/nucleon at 12 GeV and (6.8 ± 0.9) μb/nucleon at 6 GeV. The ratios of the mean values of the longitudinal and transverse cross sections are respectively 0.46 ± 0.15 and 0.25 ± 0.15. These values are very useful for a comparison between electron and muon. (auth)

46452 INCLUSIVE REACTION μ + NUCLEON → π + ANYTHING AT 10.1 AND 15.8 GeV/c. Jain, P. L.; Ahmad, Z.; Malucci, R. D.; Potoczak, M. J.; Girard, B. (State Univ. of New York, Buffalo). Lett. Nuovo Cim.; 4: No. 13, 601-7(29 Jul 1972).

It is shown that the shape and the slope of the curves for p_T^2 and p_l distributions for inclusive pion production reactions in muon-nucleon interactions at 10.1 and 15.8 GeV are the same as those in hadronic reactions, indicating that the muon-nucleon interactions behave like a hadron. The distribution $d\sigma/dY$, where Y is the rapidity variable, does not show the exact limited target fragmentation at these energies. (L.B.S.)

46453 EXPERIMENTAL LIMIT ON THE NEUTRAL CURRENT IN THE SEMILEPTONIC PROCESSES. Lee, W. (Columbia Univ., New York). Phys. Lett.; 40B: No. 3, 423-5(10 Jul 1972).

A search was made for the reactions $\nu_\mu + n \rightarrow \nu_\mu + n + \pi^0$ and $\nu_\mu + p \rightarrow \nu_\mu + p + \pi^0$ in a large optical spark chamber as a test for the presence of neutral currents in semi-leptonic weak interactions. No candidate for either reaction was observed. With 90% confidence, the upper limit for the neutral current reactions was found to be: $\{\sigma(\nu_n + p \rightarrow \nu_\mu + \pi^0 + p) + \sigma(\nu_\mu + n \rightarrow \nu_\mu + \pi^0 n)\}/2\sigma(\nu_\mu + n \rightarrow \mu^- + \pi^0 + p) < 0.14$. (auth)

46454 EXPERIMENTAL SEARCH FOR SOME RARE K^+ DECAY MODES. Ljung, Donovan Allen. Madison, Wis.; Univ. of Wisconsin (1972). 140p. University Microfilms Order No. 72-15,367.

Thesis.

The stopped K^+ decays, $K^+ \rightarrow \pi^+\gamma\gamma$, $K^+ \rightarrow \pi^0\pi^0 e^+\nu$, and $K^+ \rightarrow \pi^+\pi^0\gamma$ have been searched for in the 40″ heavy liquid bubble chamber at Argonne National Laboratory. The chamber was filled with CF_3Br. No examples of the $K^+ \rightarrow \pi^+\gamma\gamma$ decay mode were found. The experiment was sensitive to pions with kinetic energy 6 to 102 MeV and 114 to 127 MeV. Due to the sensitivity at the lower end of the pion spectrum, a test could be made of the Fujii model. This model uses an off-mass-shell extrapolation of the $K\pi_2$ amplitude to make predictions for this decay. The experimental upper limit on the branching ratio is reported to be 2.2×10^{-5} at the 90% confidence level assuming the pion spectrum appropriate for the Fujii model. This result is inconsistent with the branching ratio predicted by the Fujii model. Assuming a phase space model for the pion spectrum, the upper limit is 3.5×10^{-5} at the 90% confidence level. The decay $K^+ \rightarrow \pi^0\pi^0 e^+\nu$ was observed for the first time. Two events were found in which all four converted gammas were seen. These two events give a branching ratio of $1.8^{+1.4}_{-0.8} \times 10^{-5}$ for this deca . The form factor f_1 for the decay is reported as $|f_1| = 0.97^{+0.20}_{-0.18}$. These results are in good agreement with $\Delta I = \frac{1}{2}$ rule predictions. The study of $K^+ \rightarrow \pi^+\pi^0\gamma$ determined the strength of two direct contributions to this decay as compared with the internal bremsstrahlung contribution. The direct contributions are E1 and M1 dipole radiation, and their respective strengths are given by the parameters γ and β. Twenty-two radiative $K\pi_2$ events with three converted gamma rays were analyzed. The experiment was sensitive to positive pions with kinetic energy 55 to 102 MeV. (Diss. Abstr. Int., B)

46455 EXPERIMENTAL STUDY OF K^+ DECAY. Chiang, I-hung. Rochester, N. Y.; Univ. of Rochester (1972). 114p. University Microfilms Order No. 72-18,807.

Thesis.

An array of optical spark chambers was used to study the decay of 1.84 GeV/c K^+ in flight. The experiment was performed using a partially separated K^+ beam at the Argonne National Laboratory Z.G.S. Accelerator. The apparatus was sensitive to all decay modes, and had a high detection efficiency for the two γ rays from the π^0. The six principal decay channels of the K^+ were observed in a relatively bias-free fashion. A total of 90,000 events having K^+ decays originating in a specified fiducial region were sorted among these modes. $K_{\mu 3}$ and $K_{\pi 2}$ decays were separated by kinematical analysis using events in which both π^0 γ rays were observed. The branching ratios obtained are: $K_{\mu 2} = (63.16 \pm 0.42)\%$, $K_{\pi 2} = (21.15 \pm 0.26)\%$, $\tau = (5.55 \pm 0.20)\%$, $\tau' = (1.84 \pm 0.06)\%$, $K_{\mu 3} = (3.26 \pm 0.16)\%$, and $K_{e3} = (5.04 \pm 0.11)\%$. The 2γ opening angle distribution in the K_{e3}^+ data was also studied. $\lambda_+ = 0.04 \pm 0.015$ was found. Using this value of λ_+ and the $K_{\mu 3}$ to K_{e3} branching ratio $\xi(0) = -0.36^{+0.29}_{-0.31}$ was obtained. (Diss. Abstr. Int., B)

Strong (Baryon-induced)

Refer also to abstracts: 45647, 46590–46592, 46629, 46861, and 46872.

46456 (COO–1112–75) 200-GeV PROTON–PROTON ELASTIC SCATTERING AT HIGH TRANSVERSE MOMENTUM. Ratner, L. G. (Argonne National Lab., Ill.); Krisch, A. D.; Roberts, J. B.; Terwilliger, K. M. (Michigan Univ., Ann Arbor). 5 Jun 1970. 22p. Dep. NTIS.

This is a proposal to study p-p elastic scattering at the highest possible P_L^2 at NAL, using a CH_2 or H_2 target placed directly in the extracted beam and a double arm spectrometer. It is expected to be able to set an upper limit at the level $(d\sigma/dt/d\sigma/dt)_{t=0} \approx 10^{-14}$. This would be sufficient to determine if there are exactly three regions in the p-p interaction with considerable precision. (auth)

46457 (KFK-1509) PROTON-PROTON FINAL STATE INTERACTION IN THE REACTION d + p → p + p + n. Matthaey, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Mar 1972. 77p. (In German). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Karlsruhe Univ. (West Germany).

The proton-proton final state interaction in the reaction d + p → p + p + n was investigated systematically by kinematically complete experiments using the 52.3 MeV external deuteron beam of the Karlsruhe Isochronous Cyclotron. The analysis of the data in terms of a slightly modified Watson Migdal ansatz resulted in typical values of the p-p scattering length which are in good agreement with the value known from free p-p scattering. (The same holds for the value of n-p singlet scattering length measured under the same kinematical conditions, as compared with the result of free n-p scattering.) In a special set of experiments the angular distribution of final state interacting p-p and n-p pairs in their c.m. system was measured in order to test the applicability of the two step reaction model to the reaction under investigation. Finally a new approach to a simple theory of proton-proton final state interaction was developed. Within the framework of this model the reaction is assumed to proceed via a two step process with a zero range break-up mechanism in the first step which is followed by a p-p final state interaction. The model includes pure Coulomb final state interaction in all partial waves. The results of the calculation are in good agreement with experimental data. (auth)

46458 QUANTUM NUMBERS AND TOTAL AND PARTIAL WIDTHS OF THE RESONANCE $N\bar{N}(1970)$. Dal'karov, O. D.; Kerbikov, B. O.; Shapiro, I. S. (Inst. of Theoretical and Experimental Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 15: No. 7, 305-8(5 Apr 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 7, 430-4(5 Apr 1972).

The meson $N\bar{N}(1970)$ has been observed in the interaction $\bar{p} + p \rightarrow K_S^0 + K_L^0$ and in backward elastic $\bar{p}p$ scattering. Based on these data, a value for the ratio $\Gamma_{N\bar{N}}/\Gamma$ was estimated in several ways. Since the result was of the order of magnitude of unity, it was concluded that the $N\bar{N}(1970)$ meson is a resonant state in the nucleon-antinucleon system. It was determined to be a $^3D_3$ state with the quantum numbers $I^{PC} = 3^{--}$. (R.W.R.)

46459 PARTICLE PRODUCTION IN PROTON INTERACTIONS IN NUCLEI AT 24 GeV/c. Eichten, T. (Physikalische Inst., Aachen); Haidt, D.; Pattison, J. B. M.; (and others). Nucl. Phys.; B44: No. 2, 333-43(1972).

Particle production by 24 GeV/c protons from Be, B_4C, Al, Cu, and Pb was measured. Pion, kaon, proton and antiproton production spectra measured over a range of angles from 17 to 127 mrad and momenta from 4 to 18 GeV/c are given in a table. (auth)

46460 EXPERIMENTAL DETERMINATION OF THE TWO-PARTICLE CORRELATIONS IN 60 GeV/c π^-p AND 67 GeV/c pp INCLUSIVE REACTIONS. Fialkowski, K.; Rybicki, K.; Wit, R. (Jagellonian Univ., Krakow). Nucl. Phys.; B44: No. 2, 509-19 (1972).

Two-particle correlations are studied for inclusive π^-p interactions at 60 GeV/c and pp collisions at 67 GeV/c. Positive correlations are observed for slow c.m.s. particles. (auth)

46461 COLLECTIVE INTERACTIONS OF NUCLEONS OF HIGH-ENERGY COSMIC HEAVY NUCLEI. Grigorov, N. L.; Zhuravlev, D. A.; Kozlov, B. D.; (and others) (Moscow State Univ.). Dokl. Akad. Nauk SSSR; 202: No. 1, 65-6(Jan 1972). (In Russian).

Available experimental data are used in preliminary studies to show that nucleons which are bound in nuclei form pions of high energy with greater probability than free protons of the same energy. Two experimental approaches to a search for collective interactions of nucleons with complex nuclei are given: the study of pion spectra generated by nuclei of known energy, and the measurement of the distribution of the portion of energy transferred to all π^0-mesons during the interaction of a nucleus with known z and known energy. (K.S.W.)

46462 POLARIZATION AT LARGE ANGLES. Yokosawa, A. (Argonne National Lab., Ill.). pp 117-43 of High Energy Phenomenology. /Tran Thanh Van, J. (ed.). Paris; Laboratoire de Physique Theorique et Hautes Energies (1971).

From Conference of Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971). See CONF-710345-(Vol.2).

Polarization parameters in the backward region and at large momentum transfer (2.0 to 5.0 GeV/c) are discussed. Previous experimental data obtained for the backward peaks in $\pi^\pm p$, $K^\pm p$, and pp and $\bar{p}p$ elastic scattering are successively examined and compared with the theoretical baryon exchange models with or without Regge cuts. (France)

46463 COMPARISON OF $\bar{p}p \rightarrow \pi^-\pi^+(K^-K^+)$ ANNIHILATIONS AND $\pi^\pm p(K^\pm p)$ BACKWARD ELASTIC SCATTERING WITH CROSSING SYMMETRY PREDICTIONS. Baglin, C. (CERN, Geneva. Ecole Polytechnique, Paris). pp 233-46 of High Energy Phenomenology. /Tran Thanh Van, J. (ed.). Paris; Laboratoire de Physique Theorique et Hautes Energies (1971).

From Conference of Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971). See CONF-710345-(Vol. 2).

Recent data obtained for $\bar{p}p$, $\pi^\pm p$, $K^\pm p$ elastic scattering, and $\bar{p}p$ annihilations into $\pi^-\pi^+$ and K^-K^+ at 5 GeV/c allowed crossing relations to be experimentally checked. Quantitative comparisons between meson-nucleon backward elastic differential cross sections and the corresponding $\bar{p}p$ annihilations cross sections are presented, the correction factor R defined by Barger and Cline being taken into consideration. (France)

46464 ELASTIC SCATTERING AND ISOBAR PRODUCTION IN PROTON-PROTON COLLISIONS. Matthiae, G. (Istituto Superiore di Sanita, Rome). pp 373-96 of High Energy Phenomenology. /Tran Thanh Van, J. (ed.). Paris; Laboratoire de Physique Theorique et Hautes Energies (1971).

From Conference of Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971). See CONF-710345-(Vol.2).

Recent results obtained for elastic scattering and two-body inelastic processes in proton-proton collisions are given. A structure is shown in pp elastic scattering around $1,5(GeV)^2$. This structure develops rapidly between 7 and 10 GeV/c and becomes more pronounced for further increases in energy. Evidence is given for the excitation of the nucleon resonances N(1520), N(1688), N(2190) and N(1400) in the two-body inelastic process. N(1520) and N(1688) cross sections exhibit a gradual change in slope inside the t region where the elastic scattering is structured. The momentum transfer dependence of these processes for $2 \leq t \leq 7(GeV)^2$ is the same as for elastic scattering. (France)

46465 PROPERTIES OF MESON RESONANCES AS OBSERVED IN $\bar{p}-p$ ANNIHILATIONS AT REST. Montanet, L. (CERN, Geneva). pp 425-55 of High Energy Phenomenology. /Tran Thanh Van, J. (ed.). Paris; Laboratoire de Physique Theorique et Hautes Energies (1971).

From Conference of Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971). See CONF-710345-(Vol. 2).

Experimental data obtained for $\bar{p}-p$ annihilation at rest are presented and analyzed in terms of the final-state interaction model. Indications of the presence of at least one scalar resonance, the epsilon, and perhaps a second resonance in the 1200-MeV region exist, the two resonances being separated by a zero of the $\pi^+\pi^-$ S-wave amplitude at 940 MeV. The $\omega^0\pi^\pm$ enhancement observed at 1250 MeV is shown to be an impure state, two resonances probably being present, the B-meson $J^P = 1^+$, and the ρ $J^P = 1^-$ or a π' $J^P = 0^-$. Veneziano amplitudes favor the second solution. The $\eta^0\pi^\pm$ enhancement also observed at 1300 MeV is shown to be associated to a 2^+ or a 0^+ resonance (1^- resonance being excluded). (France)

46466 NEUTRON MATTER. Vlasov, N. A. At. Energ. (USSR); 33: No. 1, 539-45(Jul 1972). (In Russian).

The status of knowledge of nucleon structure and neutron stars is considered. Strong inelastic scattering of up to 20-GeV electrons by nucleons is evidence for the existence in nucleons of almost point components called partons. The discovery of pulsars attests to the existence of neutron stars having densities at their center exceeding nuclear densities, magnetic fields of the order of 10^{12} oersted, neutron superfluidity in the star mantle, and a variegated nuclear composition in the hard crust. (4 figures) (auth)

46467 DISCUSSION OF AN ENHANCEMENT AT ABOUT 2700 MeV/c^2 IN THE EFFECTIVE MASS OF THE $p\pi^-X^0$ SYSTEM IN THE REACTION pp → $pp\pi^+\pi^-X$ AT 19 GeV/c INCIDENT-PROTON MOMENTUM. Haldorsen, J.; Jacobsen, T. (Univ. of Oslo). Nuovo Cim.; 10A: No. 3, 468-74(1 Aug 1972).

In the reaction pp → $pp\pi^+\pi^-X^0$ at 19 GeV/c an enhancement is seen in the effective mass of the $p\pi^-X^0$ system at about 2700 MeV/c^2, which probably is due to $\Delta(2850)$ production. A lower limit of $^9/_2$ is found for the spin of the $\Delta(2850)$. (auth)

46468 STUDY OF THE REACTIONS $\bar{p}p \rightarrow \bar{p}p$ AND $\bar{p}p \rightarrow \pi^-\pi^+x$ USING A POLARIZED PROTON TARGET. Etkin, Asher. New

Haven; Yale Univ. (1971). 208p. University Microfilms Order No. 72-16,319.

Thesis.

The results of measurements of asymmetry in $\bar{p}p \to \pi^+\pi^-$ (1.6 GeV/c incident $\bar{p}$ momentum) and $pp \to pp$ (1.6 and 2.5 GeV/c incident $\bar{p}$ momenta) are presented. The $pp \to \pi^+\pi^-$ asymmetries were generally large and positive over the angular range covered. Asymmetries for $\bar{p}p \to \bar{p}p$ were also generally positive. The $\bar{p}p \to \pi^+\pi^-$ asymmetry data are the first such data obtained and have been fitted, along with all other $\bar{p}p \to \pi^+\pi^-$ data, to a partial wave expansion. The $\bar{p}p \to \bar{p}p$ data were parameterized by a spin-dependent diffraction model. An extensive description of a lanthanum magnesium nitrate polarized proton target is presented. Particular attention is paid to the nuclear magnetic resonance system used to measure the target polarization, and to non-linearity effects. Because the cryogenic system is somewhat unusual, an exhaustive description is given. The system described has several notable features: stable calibration, small non-linearity corrections, and automated measurement of polarization. The high resolution detection apparatus permitted the asymmetry measurements of the rare reaction $\bar{p}p \to \pi^+\pi^-$. This system also permitted a unique measurement to be made of the spatial distribution of the target polarization. (Diss. Abstr. Int., B)

46469 ANTIPROTON–PROTON INTERACTIONS FROM 1.51 TO 2.90 GeV/c. **Parker, Donald Lester.** East Lansing, Mich.; Michigan State Univ. (1971). 109p. University Microfilms Order No. 72-16,490.

Thesis.

In a bubble chamber experiment cross sections were obtained for zero, two, four, six and eight prong topologies, and the reaction cross sections and resonance production cross sections within each topology were obtained for nine antiproton momenta from 1.51 to 2.90 GeV/c. The extrapolation of small angle elastic scattering to t = 0 is discussed and compared with the results of other experiments. The differential cross sections are fitted to an adaptation of the Frahn–Venter optical model and also compared to Regge pole model predictions. All other channels are investigated with particular emphasis given to discovering the origin of the structure seen in the total cross section for antiproton–proton scattering. The structure cannot be explained as threshold effects, and viewed as direct channel effects, some channels can be ruled out as the origin of the structure. Pion multiplicity in the all-pionic annihilations was also investigated and comparisons of the predictions of a statistical model and a multiperipheral model are made. (Diss. Abstr. Int., B)

46470 FORWARD DIFFERENTIAL CROSS SECTION IN $\bar{p}p \to \bar{n}n$. Pittman, Roland Nathan. Stony Brook, N. Y.; State Univ. of New York (1972). 73p. University Microfilms Order No. 72-16,967.

Thesis.

The forward charge exchange reaction $\bar{p}p \to \bar{n}n$ was studied in an experiment at Brookhaven AGS. The incident antiprotons were identified by time of flight and a Cerenkov counter (at momenta above 2 GeV/c). The antineutrons and neutrons were detected with similar steel-scintillator sandwich hodoscope detectors. A liquid hydrogen target was used. Differential cross section data were taken at forty momenta from 1.00 to 3.17 GeV/c in 3% steps. The four-momentum transfer bite subtended was $|t| \leq .12(\text{GeV/c})^2$. Results are given for the differential cross section $d\sigma/dt$ and $d\sigma/d\Omega$. Two features of the data are (1) the observation of a sharp forward peak for $|t| \leq .02(\text{GeV/c})^2$ with a width of about one pion mass squared and (2) s dependent structure in the differential cross section which can be interpreted as direct channel resonance formation. The slope of $d\sigma/dt$ for $|t| \leq .02(\text{GeV/c})^2$ is smaller than that predicted on the basis of a π-exchange Regge model; this, however, is consistent with the experimental t-resolution in the forward peak region. The angular dependence of the structure is consistent with a direct channel resonance of spin $3 \leq J_R \leq 5$. Its mass and width are consistent with those found in a previous study of the $\bar{p}p$ and $\bar{p}d$ total cross sections (M = 2190 MeV, Γ = 85 MeV). (Diss. Abstr. Int., B)

Strong (Meson-induced)

Refer also to abstracts: 45651, 46517, 46636, and 46869.

46471 (BNL–16954) EVIDENCE FOR EXISTENCE OF A NEW MESON IN THE 955 MeV MASS REGION. **Eisner, Robert L.** (Brookhaven National Lab., Upton, N. Y.). 5 Jun 1972. 17p. (CONF-720409–5). Dep. NTIS.

From third international conference on experimental meson spectroscopy; Philadelphia, PA. (28 Apr 1972).

Evidence is presented for the existence of a new meson in the 955 MeV mass region. The properties of the M(953) are compared with those of the well-known η'(958). (auth)

46472 (CONF-710816–12) MEASUREMENT OF THE RADIATIVE NEUTRAL DECAY MODES OF THE ω^0 AND ϕ^0 MESONS WITH THE ORSAY STORAGE RING. Benaksas, D.; Cosme, G.; Jean-Marie, B.; (and others) (Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire). 1971. 18p. Dep. NTIS (U. S. Sales Only).

From International symposium on electron and photon interactions at high energies; Ithaca, N. Y. (23 Aug 1971).

The branching ratios for the decays $\phi^0 \to \eta^0(\pi^0) + \gamma$, $\omega^0 \to \pi^0 + \gamma$, $\omega^0 \to \pi^+ + \pi^- + \pi^0$, and $\omega^0 \to 2\pi^0 + \gamma$ are found using a large solid angle detector. (J.F.P.)

46473 (COO-1195-239) STUDY OF A_3 IN $\pi^-p \to \pi^+\pi^-\pi^-p$. Ascoli, Giulio (Illinois Univ., Urbana). [nd]. Contract AT(11-1)-1195. 9p. (CONF-720409-4). Dep. NTIS.

From third international conference on experimental meson spectroscopy; Philadelphia, PA. (28 Apr 1972).

Analysis of bubble chamber and spark chamber data on the reaction $\pi^-p \to p\pi^+\pi^-\pi^-$ at incident momenta from 11 to 40 GeV, shows that the A_3 enhancement in the $\pi^+\pi^-\pi^-$ system has $J^P = 2^-$, M = 1.65 GeV, Γ = 0.27 GeV, and decays entirely into $f^0\pi^-$. The phase of the A_3 does not show a resonant behavior. (auth)

46474 (COO-1428-306) FINAL STATES WITH THREE CHARGED PARTICLES AND A VISIBLE Λ FROM K^-d INTERACTIONS AT 4.5 GeV/c. Ammann, A. C.; Carmony, D. D.; Garfinkel, A. F.; Gutay, L. J.; Miller, D. H. (Purdue Univ., Lafayette, Ind. Dept. of Physics); Yen, W. L. (Indiana-Purdue Univ., Indianapolis. Dept. of Physics). 1972. Contract AT(11-1)-1428. 59p. Dep. NTIS.

A study is made of four or five body final states produced by the interaction of 4.48 GeV/c K^- mesons on neutrons. The data result from a 372,000 picture exposure in the Argonne National Laboratory 30 in. deuterium-filled bubble chamber. The reactions studied include $K^-n \to \Lambda\pi^+\pi^-\pi^-$, $K^-n \to \Sigma^0\pi^+\pi^-\pi^-$, $K^-n \to \Lambda\pi^+\pi^-\pi^-\pi^0$, $K^-n \to \Lambda\pi^+\pi^-\pi^-$mm, $K^-n \to \Lambda\pi^-K^+K^-$, and $K^-n \to \Lambda\pi^-K^0_1K^0_2$, where all the lambda particles decayed visibly. Evidence is presented for the existence of the $\Sigma(1640)$ whose mass and width are 1642 ± 12 MeV/c^2 and 55 ± 24 MeV/c^2, respectively. The branching ratios are found to be consistent with an octet assignment. The A_2 data are presented and are compatible with $J^{PC} = 2^{++}$. In addition, the productions of ρ^0, ω, and φ^0 are discussed in conjunction with simultaneous $\Sigma^-(1385)$ production and the results are compared to quark model predictions. (auth)

46475 (IS–2886) OBSERVATION OF THE $M^0(940)$ AND $\delta^0(963)$. Cheshire, D. L.; Jacobel, R. W.; Lamb, R. C.; Peterson, F. C. (Iowa State Univ. of Science and Technology, Ames); Hoffman, E. W. (Argonne National Lab., Ill.); Garfinkel, A. F. (Purdue Univ., Lafayette, Ind.). 1 Jun 1972. 9p. (CONF-720409-7). Dep. NTIS.

From third international conference on experimental meson spectroscopy; Philadelphia, PA. (28 Apr 1972).

In a scintillation counter experiment two narrow, neutral mesons denoted $M^0(940)$ and $\delta^0(963)$ in the reaction $\pi^-p \to M^0n$ at 2.4 GeV/c were observed. Also the well established η'(958) was observed. (auth)

46476 (JINR-P1-6408) INVESTIGATION OF GENERATION OF PARTICLES AND RESONANCE STATES IN INTERACTIONS OF 2.34 GeV/c, 5 GeV/c, AND 9 GeV/c π-MESONS WITH XENON NUCLEI. Slovinskii, B.; Strugal'skii, Z. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1972. 13 p. (In Russian). Dep. NTIS (U. S. Sales Only).

The results of investigation of particle generation, mainly of π^0-mesons and resonance states, in π–Xe interactions are described. (auth)

46477 (LBL-378) STUDY OF DIPION PRODUCTION IN THE REACTION $\pi^-p \to \pi^0\pi^0n$ BETWEEN 1.6 AND 2.4 GeV/c. Skuja, Andris (California Univ., Berkeley. Lawrence Berkeley Lab.). 25 Feb 1972. Contract W-7405-eng-48. 172p. Dep. NTIS.

Thesis.

An experiment was performed at the Berkeley Bevatron to study the I = 0, J = 0 $\pi-\pi$ system in the reaction $\pi^-p \to n\pi^0\pi^0$, at beam momenta of 1.60 to 2.40 GeV/c in 0.20-GeV/c intervals. The reaction occurred in a 20-cm liquid hydrogen target and the final state was identified by detecting the neutron and the γ-rays from the π^0 decays. The detection system consisted of a large cubic array of lead-plate optical spark chambers surrounding the target for converting γ-rays and a set of 20 plastic-scintillator neutron counters to measure time-of-flight and direction from the target, in the polar-lab-angle region of 12 to 72 degrees. The spark chambers were seven to eight radiation lengths thick and

covered five sides of a cube, with the sixth side (beam entrance face) being nearly closed by lead-scintillator sandwich gamma counters. A sample of 5000 four-gamma events was obtained that passed the kinematic fit to the hypothesis $\pi^-p \rightarrow \pi^0\pi^0n$ with a 1% confidence level. The total cross sections for the production of $\pi^-p \rightarrow \pi^0\pi^0n$ at each incident momentum were obtained. The dipion production distribution was parametrized using a modified one pion exchange model with form factors, and the off-mass-shell $\pi\pi$ scattering matrix element extracted. It was found that the $\pi^0\pi^0$ production distribution was more peripheral than the OPE model predictions and that above 850 MeV of the dipion mass, the matrix element varied rapidly, indicating a rapid variation of the I = 0, J = 0, phase shift in this region. It was also found that at low t, the reaction had substantial Δ^0 production (~50%). (auth)

46478 (ORNL-tr-2544) CROSS SECTION OF PION–NUCLEON INTERACTIONS. Barashenkov, V. S.; Okhlopkova, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR)). Translated for Oak Ridge National Lab., Tenn., from report JINR-P2-5924. 3p. Dep. NTIS.

Interpolation curves for total cross sections previously presented are refined and followed up to the high energy region for the reactions π^- + p and π^+ + p. The total cross sections for elastic scattering, elastic scattering with charge exchange, and inelastic scattering for these reactions are given. (J.F.P.)

46479 (ORO-3065-24) PROGRESS REPORT [ON HIGH-ENERGY PHYSICS], JULY 1, 1971–JUNE 30, 1972. Walker, W. D.; Fortney, L. R. (Duke Univ., Durham, N. C. Dept. of Physics). 10 Jul 1972. Contract AT(40-1)-3065. 6p. Dep. NTIS.

A summary of research on the π^+ + d experiment and pion reactions with neon is given. (J.F.P.)

46480 K^-–p INTERACTIONS AT 10 GeV/c. Buschbeck, B.; Froehlich, A.; Markytan, M.; (and others) (Institut fuer Hochenergiephysik, Vienna). Oesterr. Akad. Wiss., Math.-Naturwiss. Kl., Sitzungsber., Abt. II; 179: No. 8-10, 280-303(1971). (In German).

Presently available information about K-p interactions at 10 GeV/c was reviewed. There were 3,600 bubble chamber events which yielded for the K-p elastic scattering a cross section of 3.20 ± 0.14 mb, with a ratio of elastic to total cross section of 0.142 ± 0.006. This value was somewhat lower than the 0.185 predicted as the upper limit by the Van Hove model for asymptotic energies. The dynamics of two-body reactions, quasi-two-body reactions, and multibody reactions were theoretically analyzed, and the data were compared with the experimental findings. Up to May 1969, seven Ω^- were discovered. Their decay was established as well as a new resonance demonstrated. (H.B.G.)

46481 PION EXCHANGE IN THE REACTION $\pi p \rightarrow pN$ AT 6 GeV/c. Scarr, J. Michael; Lai, Kwan-wu (Brookhaven National Lab., Upton, N. Y.). Phys. ReV. Lett.; 29: No. 5, 310-12 (31 Jul 1972).

A dip was observed at $-t \simeq 0.5$ GeV^2 in $(\rho_{00}^H d\sigma/dt)(\pi p \rightarrow \rho N)$ for ρ^-, ρ^0, and ρ^+ at 6 GeV/c. The dominant contribution to $(\rho_{00}^H d\sigma/dt)$ $(\pi p \rightarrow \rho N)$ is from π exchange. (auth)

46482 CHARGE ASYMMETRY IN THE DECAY $\eta \rightarrow \pi^+\pi^-\gamma$. Thaler, J. J.; Appel, J. A.; Kotlewski, A.; (and others) (Columbia Univ., New York). Phys. Rev. Lett.; 29: No. 5, 313-16(31 Jul 1972).

The charge asymmetry in the decay $\eta \rightarrow \pi^+\pi^-\gamma$ was measured. η mesons were produced in the reaction $\pi^-p \rightarrow \eta n$ at 730 and 810 MeV/c incident pion momentum. The asymmetry is 0.005 ± 0.006 for 36 155 events. No evidence for C-invariance violation in this decay was seen. (auth)

46483 MEASUREMENT OF THE CHARGE ASYMMETRY IN THE DECAY $\eta \rightarrow \pi^+\pi^-\pi^0$. Layter, J. G.; Appel, J. A.; Kotlewski, A.; (and others) (Columbia Univ., New York). Phys. Rev. Lett.; 29: No. 5, 316-19(31 Jul 1972).

The charge asymmetry in the decay $\eta \rightarrow \pi^+\pi^-\pi^0$ was measured. η's were produced in the reaction $\pi^-p \rightarrow \eta n$ at 730 and 810 MeV/c incident pion momentum. An asymmetry of -0.0005 ± 0.0022 was obtained for 220 659 events. No evidence for C-invariance violation in this decay was seen. (auth)

46484 EXPERIMENTAL SPECTRA FOR 12 GeV/c $k^+p \rightarrow pK^+\phi$ AND $pK^+\omega$. Davis, Philip J.; Alston-Garnjost, Margaret; Barbaro-Galtieri, Angela; (and others) (Univ. of California, Berkeley). Nucl. Phys.; B44: No. 2, 344-54(1972).

Experimental distributions are presented for the reactions $K^+p \rightarrow pK^+\phi$, $\phi \rightarrow K^-K^+$ and $K^+p \rightarrow pK^+\omega$, $\omega \rightarrow \pi^-\pi^+\pi^0$ at 12 GeV/c. The data were obtained from a 35 events/μb exposure of the SLAC 82-inch HBC. The cross sections for these reactions are (11 ± 1) μb and (47 ± 3) μb. Kϕ, Kω, and pω low-mass enhancements were observed with no evidence for narrow structure. The momentum-transfer and angular-decay spectra of these systems are presented. (auth)

46485 REACTIONS $K^- + p \rightarrow \Lambda(\Sigma^0)$ + VECTOR MESON AT 3.95 GeV/c. Rouge, A. (Ecole Polytechnique, Paris); Videau, H.; Videau, L.; (and others). Nucl. Phys.; B44: No. 2, 365-89(1972).

Complete results, concerning the five reactions $K^-p \rightarrow \Lambda\omega$, $K^-p \rightarrow \Lambda\phi$, $K^-p \rightarrow \Lambda\rho$, $K^-p \rightarrow \Sigma^0\rho$, and $K^-p \rightarrow \Sigma^0\rho$, are presented. The experimental data are well described by exchange mechanisms and the agreement with the SU(3) symmetry predictions is excellent. (auth)

46486 CROSS SECTIONS FOR (π^-,π^-n) REACTIONS ON ^{19}F AND ^{31}P IN THE 3 TO 3 RESONANCE REGION. Plendl, H. S. (Florida State Univ., Tallahassee); Burch, D.; Eberhard, K. A.; (and others). Nucl. Phys.; B44: No. 2, 413-21(1972).

Activation cross sections for the reactions $^{19}F(\pi^-,\pi^-n)^{18}F$ and $^{31}P(\pi^-,\pi^-n)^{30}P$ were measured at pion energies from 140 to 240 MeV and found to reach maxima of 39 ± 5 mb and 60 ± 11 mb, respectively, near 180 MeV. The results are compared with calculated cross sections and with the results of other measurements. (auth)

46487 INTERACTION OF K^- MESONS WITH NUCLEI. Burhop, E. H. S. (University Coll., London). Nucl. Phys.; B44: No. 2, 445-59(1972).

The experimental data for K^- capture by nuclei is interpreted in terms of K^- nucleon scattering amplitudes in a region of negative relative kinetic energy. It is shown that constant scattering length solutions which represent the data in the region of positive relative kinetic energy up to 100 MeV do not satisfactorily describe the interaction with bound nucleons and a modified scattering length solution is proposed. Measured values of the widths of K-mesic X-ray lines which require a strongly attractive K^- nucleons optical potential are successfully interpreted in terms of K^-N scattering lengths appropriate for bound nucleons. The information obtainable about relative neutron and proton density distributions in the nuclear periphery from studies of this kind is discussed. The need for more data on interactions of K^- in hydrogen at low kinetic energies and at rest and in other elements at rest is emphasized. (auth)

46488 FORWARD PRODUCTION OF DELTA(1236) IN PION–PROTON SCATTERING. Derado, I. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). pp 39-47 of High Energy Phenomenology. /Tran Thanh Van, J. (ed.). Paris; Laboratoire de Physique Theorique et Hautes Energies (1971).

From Conference of Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971). See CONF-710345-(Vol.2).

The following reactions were studied: $\pi^-p \rightarrow \pi^-\pi^+n$ and $\pi^-p \rightarrow \pi^-\pi^0p$ around 4 GeV/c. Only events with $\cos\theta \geq 0$ were considered. Theta being the overall c.m.s. angle between the incident pion and the nucleon pion system. Effective masses were investigated for the $n\pi^-$, $p\pi^-$ and $p\pi^0$ systems. The only statistically significant structure was observed in the $n\pi^-$ effective mass. The angular distribution of π^- in $n\pi^-$ (c.m.s.) is presented. The differential cross sections for Δ^-, Δ^+, Δ^0 and Δ^{++} are given as a function of U (momentum transfer). They were calculated for $U = 0$ and $U = U_{max} = 0.2(GeV/c)^2$ in the case of Δ^{++} and Δ^-. Theoretical values and experimental results are compared. (France)

46489 EXPERIMENTAL SURVEY OF THE REACTIONS $\bar{K}N \rightarrow \pi Y$ AT MEDIUM AND HIGH ENERGY. Barloutaud, R. (CEN de Saclay, Gif-sur-Yvette, France). pp 49-63 of High Energy Phenomenology. /Tran Thanh Van, J. (ed.). Paris; Laboratoire de Physique Theorique et Hautes Energies (1971).

From Conference of Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971). See CONF-710345-(Vol. 2).

Recent results obtained for two body or quasi two body reactions of the $\bar{K}N \rightarrow \pi Y$ type, above 3 GeV/c, are surveyed as far as the simplest description seems to be a description in terms of meson or baryon exchange. Total cross sections are given. Forward scattering is discussed: upper limit of the $I = 3/2$ t channel amplitude; shape of $d\sigma/dt$ distribution; polarization; comparison with $\pi N \rightarrow KY$ reversed line reactions. Results obtained for backward scattering are also summarized. (France)

46490 POLARIZATION IN $\pi^\pm$–p BACKWARD ELASTIC SCATTERING AT HIGH ENERGY. Poulet, M. (Univ. Paris, Orsay, France). pp 97-104 of High Energy Phenomenology. /Tran Thanh Van, J. (ed.). Paris; Laboratoire de Physique Theorique et Hautes Energies (1971).

From Conference of Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971). See CONF-710345-(Vol. 2).

The polarization parameter in backward elastic scattering $\pi p \rightarrow p\pi$ at 6 GeV/c was measured. The following two parameters were determined: the coplanarity of the three particles (incident, scattered, recoiled), and the angular correlations. Both must be zero for elastic backward events. Preliminary results are given. They are in disagreement with the predictions of pure Regge models and cuts based on the Carlitz–Kislinger method or the weak cut model, especially in the region of small w. (France)

46491 POLARIZATION IN CHARGE EXCHANGE REACTIONS. Guisan, O. (CEN de Saclay, Gif-sur-Yvette, France); Bonamy, P.; Borgeaud, P.; (and others). pp 105-16 of High Energy Phenomenology. /Tran Thanh Van, J. (ed.). Paris; Laboratoire de Physique Theorique et Hautes Energies (1971).

From Conference of Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971). See CONF-710345-(Vol.2).

New preliminary results concerning the polarization parameter P(t) in the $\pi^- p \rightarrow \pi^0 n$ reaction are presented. Measurements were achieved at 5.0 and 8.0 GeV/c from 0 to 2.0 $(GeV/c)^2$. The experimental lay-out is briefly described and the background problem encountered when using a polarized target is examined. Data obtained exclude a zero of P(t) for $-t \leq 0.6$ $(GeV/c)^2$. Below this value a large positive polarization was found and above this value the polarization is compatible with zero within large errors, data obtained at 5.0 and 8.0 GeV/c being quite similar. Models involving double poles or double trajectories and most of the models involving cuts or absorption are not compatible with the results obtained. Models involving rho' seem to work much better. (France)

46492 ELASTIC SCATTERING OF $\pi^\pm$, $K^\pm$, AND $\bar{p}$ ON PROTONS AT 5 GeV. Treille, D. (CERN, Geneva). pp 213-32 of High Energy Phenomenology. /Tran Thanh Van, J. (ed.). Paris; Laboratoire de Physique Theorique et Hautes Energies (1971).

From Conference of Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971). See CONF-710345-(Vol. 2).

The complete angular distributions in $\pi^\pm p$, $K^\pm p$ and $\bar{p}p$ elastic scattering at 5 GeV were measured. A good sensitivity allowed the cross sections to be accurately measured at large angles for all the reactions, the cross sections being 10^5 times smaller than in the case of forward scattering. Small backward peaks were unambiguously detected in the exotic channels: $K^- p \rightarrow pK^-$ and $\bar{p}p \rightarrow p\bar{p}$. (France)

46493 EVIDENCE FOR DOUBLE DIFFRACTIVE DISSOCIATION IN $\pi^+ p$ REACTIONS AT 5 GeV/c. Rinaudo, G. (Univ., Turin. Instituto Nazionale di Fisica Nucleare, Turin). Werbrouck, A. E.; Rost, M.; (and others). Nuovo Cim.; 10A: No. 1, 1-9(1 Jul 1972).

Evidence of double diffractive dissociation in 5 GeV/c $\pi^+ p$ reactions is found by analyzing angular distributions in selected longitudinal phase-space regions. The size of the observed effect is compatible with expectations from factorization. (auth)

46494 MEASUREMENT OF THE SLOPE PARAMETER IN THE DECAY $K_2^0 \rightarrow \pi^+\pi^-\pi^0$. Krenz, W. (Technische Hochschule, Aachen); Hopkins, H. W. K.; Evans, G. R.; Muir, J.; Peach, K. J. Lett. Nuovo Cim.; 4: No. 6, 213-19(10 Jun 1972).

The slope parameter in $K_2^0 \rightarrow \pi^+ + \pi^- + \pi^0$ decay in a heavy-liquid bubble chamber was measured. The slope parameter was found to be -0.277 ± 0.018. Also a test was made for CP violation in the charge asymmetry δ. It was found that $\delta = -0.0081 \pm 0.045$. (J.F.P.)

46495 PARTIAL WAVE ANALYSIS OF $\pi^+ p \rightarrow \pi^0 \Delta^{++}$ (1236) IN THE CENTER OF MASS ENERGY REGION 1820 TO 2090 MeV. Mehtani, Usha. Riverside, Calif.; Univ. of California (1971). 100p. University Microfilms Order No. 72-17,060.

Thesis.

The differential cross sections $d\sigma(\cos\theta_s)/d\Omega$ and Δ density matrix elements $\rho_{33}(\cos\theta_s)$, Re $\rho_{31}(\cos\theta_s)$ and Re $\rho_{3,-1}(\cos\theta_s)$ were measured for the reaction $\pi^+ p \rightarrow \pi^0 \Delta^{++}$ (1236) at seven incident momenta 1.28, 1.34, 1.42, 1.55, 1.67, 1.77 and 1.84 GeV/c. With these experimental data, an energy dependent partial wave analysis of this reaction was performed. It is found that the inelastic channel $\pi N \rightarrow \pi\Delta$ is dominated by F_{37} (1950) resonance with the branching fraction parameter $x_{\pi N} x_{\pi\Delta} = .25^{+.8}_{-.1}$. Other partial wave amplitudes which are strong in this energy interval are FF5, PP1, DD5, PP3 and SD1. Phase shift analysis in the elastic channel shows the presence of the F_{37} (1950) resonance and suggests the existence of three other resonances F_{35} (1890), P_{31} (1910) and D_{35} (1960). Of the latter three resonances only P_{31} (1910) is indicated by the data with $x_{\pi N} x_{\pi\Delta} \approx .04$. The reaction $\pi^+ p \rightarrow \pi^0 \Delta^{++}$ goes by pure ρ exchange in the t-channel. All the angular distributions have features characteristic of Regge ρ trajectory exchange, i.e., they have dips at $t \approx 0$ and $t \approx -0.5$ $(GeV/c)^2$. The s-channel partial wave amplitudes were projected from the Regge ρ amplitude. The F_{37} amplitude, which is predominant in the s-channel, is negligible here. Also P_{31} is insignificant in the ρ amplitude. However, suggestive similarities between the partial wave fits and the s-channel projections of the Regge ρ amplitude are observed. (Diss. Abstr. Int., B)

46496 RHO-MESON PRODUCTION BY PIONS AT 15 GeV/c: A STUDY OF VECTOR DOMINANCE AND OF RHO–OMEGA INTERFERENCE. Ratcliff, Blair Norman. Stanford, Calif.; Stanford Univ. (1972). 170p. University Microfilms Order No. 72-16,778.

Thesis.

The results of a wire spark chamber experiment studying the reaction $\pi^- p \rightarrow \pi^+\pi^- n$ at 15 GeV/c are presented. The differential cross section, density matrix elements, and dipion mass distributions are given in the rho region for momentum transfers (t) less than 0.30 $(GeV/c)^2$. The density matrix elements and differential cross section exhibit structure in the forward direction ($-t < m_\pi^2$). Using the vector dominance model, a comparison is made with polarized and unpolarized single-pion photoproduction data which also exhibit structure in the forward direction. Qualitative agreement with the vector dominance model is found and, in particular, the transverse rho differential cross section displays a pronounced forward peak, analogous to that observed in single-pion photoproduction. Quantitative agreement is found for the unnatural-parity-exchange cross section and for the asymmetry at small momentum transfers. Elsewhere there are disagreements in detail which may not be explained by changes in normalization or the value of the rho-photon coupling constant. The data show a significant (>4 standard deviations) rho-omega interference effect in the dipion mass distribution for $0.1 < |t| < 0.3(GeV/c)^2$. The overall phase between the amplitudes in the observed data is dominated by transverse production and is shown to be -1.40 ± 0.45 (rad) which differs from the phase found at lower energies by $\simeq -\pi/2$. The lower limit on the branching ratio $\Gamma(\omega \rightarrow 2\pi)/\Gamma(\omega \rightarrow 3\pi)$ is 0.7% at the 95% confidence level. (Diss. Abstr. Int., B)

Particle Interactions and Properties (Theoretical)

Refer also to abstracts: 46126 and 46259.

General

Refer also to abstracts: 46691 and 46791.

46497 (IFVE-STF-71-36) ANALYTICAL PROPERTIES OF AMPLITUDES AND DIFFERENTIAL CROSS-SECTIONS FOR MULTIPARTICLE PRODUCTION PROCESSES OVER TWO ANGULAR VARIABLES. Ezhela, V. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 11p. (In Russian). Dep. NTIS (U. S. Sales Only).

The amplitude of multiparticle production processes $T(s,n,\xi_i)$ and twice differential cross sections $(d^2\sigma_{inel}/d\vec{n})$ $(s,\vec{n})$ where n is a unit vector in the direction of the momentum of colliding particles considered as a function on a sphere $S^2(\vec{n}^2 = 1)$ are considered. It has been proved that both functions holomorphically continue into some domain on the complex sphere $(z_1^2 + z_2^2 + z_3^2 = 1)$. It has also been proved that $(d\sigma_{inel}/d\cos\theta)$ $(s, \cos\theta)$ analytically continues in the Lehmann ellipse. (auth)

46498 SPIN SPECTRUM OF AN UNSTABLE PARTICLE. Fleming, Gordon N. (Pennsylvania State Univ., University Park). J. Math. Phys. (N. Y.); 13: No. 5, 626-37(May 1972).

A state vector (vector-valued distribution) of an unstable particle can be a 3-momentum eigenvector in at most one inertial frame as a consequence of the necessary width of the energy spectrum. This frame dependence of momentum eigenvectors of unstable particles is investigated and it is demonstrated that: (i) It is compatible with the principle of relativity. (ii) It leads to a distinction between two ways of defining the spin of the particle which are equivalent for stable particles. (iii) One definition, called kinematical spin, yields a precise value, and is determined by considerations of detailed balancing and other means of counting the degeneracy of the momentum eigenvectors. (iv) The second definition, called dynamical spin, need not yield a sharp value, is

determined by the dynamics of the decay process, and is measured by observing angular distributions of decay products. It is shown that an unstable particle with vanishing kinematical spin (pion) may have a small admixture of nonisotropic angular distribution of unpolarized decay products in the rest frame of the decay products. The order of magnitude of the effect is estimated and the coupling between the mass and spin spectrum is studied in the case of local interactions without derivative coupling. (auth)

46499 ONE-DIMENSIONAL CAUSAL THEORY OF TACHYONS. Antippa, A. F. (Univ. of Quebec, Trois-Rivieres). Nuovo Cim.; 10A: No. 3, 389-406(1 Aug 1972).

A one-dimensional theory of tachyons, which is noninvariant under space inversion and is based on extending the Lorentz transformations to inertial coordinate systems having relative velocities greater than that of light, is given. It is shown that the theory is fully causal and exhibits a reciprocity between tachyons and bradyons according to which a tachyon with velocity $\beta > 1$ behaves as a bradyon with velocity $1/\beta < 1$ and with the space and time components of its "two-vectors" interchanged. (auth)

46500 KINEMATICALLY CORRECTED CORRELATION FUNCTIONS FOR INCLUSIVE REACTIONS. Yaes, R. J. (Johannes-Gutenberg-Univ., Mainz). Lett. Nuovo Cim.; 4: No. 13, 611-15(29 Jul 1972).

A different set of correlation functions is defined in a phase-space model for inclusive interactions, which allows the dynamic effects to be separated from the kinematic effects. Sum rules for the inclusive cross sections are obtained. (L.B.S.)

46501 GRAVITATIONAL CORRECTION TO PCAC. Delbourgo, R.; Salam, A. (Imperial Coll. of Science and Tech., London). Phys. Lett.; 40B: No. 3, 381-2(10 Jul 1972).

A simple-minded perturbation calculation to order G (the Newtonian gravitational constant) of the two-graviton coupling to a pseudoscalar (P) or axial (A) current via a fermion loop gives an anomalous contribution which can be added to the Adler term in the form $\partial_\alpha A_\alpha = 2m\,P + e^2\epsilon_{\kappa\lambda\mu\nu}F_{\kappa\lambda}F_{\mu\nu}/16\pi^2 + \epsilon_{\kappa\lambda\mu\nu}R_{\kappa\lambda\rho\sigma}R_{\mu\nu\rho\sigma}/768\pi^2$. The anomalous terms can be interpreted as arising from an infinite-mass regulating loop. (auth)

46502 GENERAL PROPERTIES OF CORRELATION FUNCTIONS FOR INCLUSIVE PROCESSES. Ballestrero, A.; Nulman, R.; Predazzi, E. (Univ., Turin. Istituto Nazionale di Fisica Nucleare, Turin). Nuovo Cim.; 10A: No. 2, 311-24(21 Jul 1972).

General properties of correlation functions for inclusive cross sections are derived from sum rules obtained earlier. In particular, a recursion formula connecting correlation functions of contiguous orders is given which expresses the kinematical constraints of energy-momentum conservation. It follows that all correlation functions are nonzero. Zero and first moments of correlation functions are then given in terms of the multiplicities. (auth)

46503 ALGEBRAIC DERIVATION OF THE GENERALIZED TALMI EXPANSION. Domany, E.; Goshen, S.; Katriel, J. (Nuclear Research Center-Negev, Beer-Sheva, Israel). Lett. Nuovo Cim.; 4: No. 9, 389-90(1 Jul 1972).

The generalized Talmi expansion, in which the product of two harmonic-oscillator wave functions is expanded in terms of relative and generalized center-of-mass dependent functions, is derived by a strictly algebraic treatment. Use is made of the fact that transition to the relative and center-of-mass coordinates is obtained by a rotation in the x_1-x_2 plane, and that the well parameter is affected by scaling of the corresponding coordinate. (L.B.S.)

46504 ENERGY–MOMENTUM CONSERVATION IN INCLUSIVE PROCESSES. Yang, T. C. (Univ. of California, San Diego, La Jolla). Lett. Nuovo Cim.; 4: No. 9, 352-6(1 Jul 1972).

The implications of energy–momentum conservation in single-particle and two-particle inclusive processes for correlation functions and cross sections are discussed. (L.B.S.)

46505 ESTIMATE OF THE QUASIPOTENTIAL PHASE SHIFT. Arkhipov, A. A. (Inst. of High Energy Physics, Serpukhov, USSR). Teor. Mat. Fiz.; 11: No. 3, 337-43(Jun 1972). (In Russian).

The quasipotential phase shift is calculated in the first and second orders with respect to the quasipotential. (auth)

46506 RELATIVISTIC WAVE FUNCTIONS FOR COMPOSITE PARTICLES. Peres, A. (Technion-Israel Inst. of Tech., Haifa). Nuovo Cim.; 10A: No. 2, 230-4(21 Jul 1972).

Clusters of free spinless particles are considered. It is shown that the relativistic wave functions of such clusters cannot be factorized into external and internal wave functions. However, an approximate factorization is still possible, provided that the invariant mass of the cluster has a narrow distribution around some mean value. In that case the internal wave function of a cluster moving with relativistic speed is obtained from that of the same cluster at rest by means of a Lorentz contraction. (auth)

46507 IRREDUCIBLE REPRESENTATIONS OF PARA-BOSE OPERATORS. Alabiso, C.; Duimio, F. (Univ., Parma, Italy. Istituto Nazionale di Fisica Nucleare, Milan). Nuovo Cim.; 10A: No. 3, 499-512(1 Aug 1972).

A general procedure is given in order to evaluate the matrix elements of the para-Bose operators of any order. As a consequence, a class of irreducible representations of the $Sp_{2n,R}$ algebra is constructed. (auth)

46508 PHYSICS IN THE TWENTIETH CENTURY: SELECTED ESSAYS. Weisskopf, Victor F. Cambridge, Mass.; Massachusetts Institute of Technology Press (1972). 380p. $7.95.

This collection of essays includes quality and quantity in quantum physics, the quantum ladder, Niels Bohr the quantum and the world, physics in the twentieth century, recent developments in the theory of the electron, the compound nucleus, problems of nuclear structure, quantum theory and elementary particles, nuclear models, the visual appearance of rapidly moving objects, light interactions with matter, the fall of parity, and the role of symmetry in nuclear, atomic, and complex structures. Also discussed are man and nature, Marie Curie and modern science, science and ethics, and the significance of science. (J.F.P.)

46509 PARTICLE PHYSICS. Lagarrigue, M. (Univ. Paris, Orsay, France). Bull. Union Physiciens; 66: No. 544, 783-853(Apr 1972). (In French).

The text of a Maitrise de Physique course given at Orsay is reproduced. The titles of the chapters are as follows: generalities about particles; the π meson; isotopic spin–strangeness–hyperchange; parity transformations and charge conjugations; weak interaction. (auth)

Electromagnetic

Refer also to abstracts: 46433, 46678, 46693, 46694, 46698, 46704, 46742, 46757, 46767, and 46867.

46510 (CALT-767-P-3-22) PERTURBATION TREATMENT OF HIGH ENERGY ELECTRON DIFFRACTION FROM IMPERFECT CRYSTALS. Lewis, Alan L.; Villagrana, Robert E. (California Inst. of Tech., Pasadena). 1970. 31p. Dep. NTIS.

A modified Bloch wave expansion is used to develop a theory of high energy electron diffraction from imperfect crystals. To compute these new Bloch waves one must solve a linear hyperbolic system in n unknowns. Scattering among the Bloch waves is controlled by the matrix elements of the perturbing potential, and various approximations to this scattering are discussed. The hyperbolic system is transformed to normal form; in making this transformation, the unknown functions become the plane wave amplitudes of the Darwin representation. The normal form reveals the region of determinacy of the system: a cone generated by the diffracted beams. The contraction of this cone to a line (the column approximation) is discussed in terms of the Bloch wave scattering. (auth)

46511 (CONF-710816–9) BEFORE APPLYING THE DISPERSION THEORY TO THE PHOTOPRODUCTION REACTIONS. Blazek, M. (Ceskoslovenska Akademie Ved, Prague. Fysikalni Ustav). [1971]. 21p. Dep. NTIS (U. S. Sales Only).

From International symposium on electron and photon interactions at high energies; Ithaca, N. Y. (23 Aug 1971).

The application of the dispersion relation techniques assumes the knowledge of the asymptotics together with the analytic properties of the amplitudes under consideration. A method is suggested which allows one to determine the locus where a partial wave amplitude for the photoreactions possesses an absorptive part in the complex s-plane. The present analysis yields the necessity of analytic continuation due to the appearance of the continua which give rise to the areas where a partial wave amplitude is not defined. Though this effect is relatively weak in the photoproduction of pions on nucleons, it is quite strong in the photoproduction of vector mesons. The complications encountered might be avoided by the (stable or unstable) particle exchanges. Then the necessity of the continuation does not appear. Suggestions for evaluation of the dispersion integrals are presented and some implications for full amplitude are mentioned. (auth)

46512 (CONF-710816–16) π^0 ELECTROPRODUCTION AT THE FIRST RESONANCE. Brasse, F. W.; Chazelas, E.; Fehrenbach, W.; (and others) (Deutsches Elektronen-Synchrotron, Ham-

burg (West Germany)). 1971. 29p. Dep. NTIS (U. S. Sales Only).

From International symposium on electron and photon interactions at high energies; Ithaca, N. Y. (23 Aug 1971).

Recent results on electroproduction of π^0 mesons in the region of the first resonance at four momentum transfers $q^2 = 0.6$ GeV^2 and $q^2 = 1$ GeV^2 are discussed and analyzed in terms of multipole amplitudes. Assuming that the angular distributions are dominated by the magnetic dipole M_{1+}, the square of the magnetic dipole amplitude and its interference terms with the multipoles E_{0+}, S_{0+}, E_{1+}, S_{1+} and M_{1-} are determined. The results are compared with theoretical models. The dependence of $|M_{1+}|^2$ on the invariant mass W at different q^2 is discussed by comparison with a standard Breit Wigner formula. (auth)

46513 (CONF-710816-17) IS THE PION FORM FACTOR DETERMINED BY ELECTROPRODUCTION EXPERIMENTS? Dombey, Norman; Read, B. J. (Sussex Univ., Brighton (England)). Aug 1971. 8p. Dep. NTIS (U. S. Sales Only).

From International symposium on electron and photon interactions at high energies; Ithaca, N. Y. (23 Aug 1971).

Experiments on pion electroproduction in the first resonance region which measure the pion form factor are reinterpreted using a very simple model in which the axial vector form factor appears explicitly. A significant correlation between F_π and G_A is found. It is concluded that the pion form factor has not yet been determined from electroproduction experiments since G_A is largely unknown. It is noted that a careful set of coincidence measurements in the region from threshold through the first resonance could determine both G_A and F_π. (J.F.P.)

46514 (CTH-ITP-71-30) NUCLEON FORM FACTORS IN A FIELD THEORY ON A HOMOGENEOUS SPACE OF THE POINCARE GROUP. Brink, Lars; Marnelius, Robert (Chalmers Tekniska Hogskola, Goteborg (Sweden). Institutionen for Teoretisk Fysik). 12 Nov 1971. 41p. Dep. NTIS (U. S. Sales Only).

The nucleon form factors are calculated to lowest order in a new field theory on an 8-dimensional homogeneous space of the Poincaré group. The simplest diagram does give both an electric and a magnetic form factor and a relation between them. It seems however, difficult to reproduce the experimental data, as e.g. any anomalous magnetic moment does not appear in a natural way. (auth) (Sweden)

46515 (DAMTP-71/24) DEEP INELASTIC ELECTROPRODUCTION AND RELATED PROCESSES. Landshoff, P. V.; Polkinghorne, J. C. (Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics). 1971. 24p. (CONF-710816-18). Dep. NTIS (U. S. Sales Only).

From International symposium on electron and photon interactions at high energies; Ithaca, N. Y. (23 Aug 1971).

The parton approach, with the partons identified as quarks, is combined with a dual model to describe deep inelastic electron and neutrino scattering. This model has the important feature that it allows a complete calculation of the nondiffractive contributions to the structure functions, essentially without free parameters. The calculated difference $F_2^{eP}(\omega) - F_2^{eN}(\omega)$, which has no diffractive contribution, is in fair agreement with experiment. The calculated form of the nondiffractive contribution to $F_2^{eP}(\omega)$ agrees well with the data for F_1^{eP} for small ω. For large ω the difference between this calculated form and the data is quite small. If this difference is identified with the diffractive contribution, the neutrino structure functions are determined. These are in agreement with the rather preliminary data. The partons are introduced through a nonperturbative field-theory formalism. This reproduces most of the results of the more phenomenological approaches, except that in the case of heavy-muon-pair production it indicates that an extra Pomeron-exchange contribution is important. When this is allowed for, good agreement with the data for this process is obtained, including the "shoulder" in the differential cross section. The picture is extended to purely hadronic processes, and leads to the results of the additive quark model as an approximation, even though the structure of the hadrons is supposed to be considerably more complicated than in the naive quark model. The Wu-Yang model and s-channel helicity conservation also emerge as natural consequences. (auth)

46516 (DESY-72/21) TESTING TRIPLET MODELS. Suura, H. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany); Walsh, T. F. (Hamburg Univ. (West Germany). Institut fuer Theoretische Physik (II); Young, Bing-Lin (Ames Lab., Iowa). May 1972. 11p. Dep. NTIS.

Radiative decays $\pi^0 \to 2\gamma$, $\omega \to \pi^0 + \gamma$, $\rho \to \pi^0 + \gamma$, $\eta \to 2\gamma$, $\epsilon(750) \to 2\gamma$, and $\eta^1 \to 2\gamma$ and $e^+ + e^-$ and $e^- + e^-$ interactions are used to distinguish the Han-Nambu and Gell-Mann-Zweig triplet quark models. (J.F.P.)

46517 (DESY-72/23) DIFFRACTION-DISSOCIATION MODEL FOR HIGH-ENERGY ELECTROPRODUCTION. Kramer, G.; Quinn, H. R. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). May 1972. 54p. Dep. NTIS (U. S. Sales Only).

A model for two-pion electroproduction in the rho resonance region is constructed. The production proceeds by diffraction-dissociation of the virtual photon into a pion pair which interacts strongly in the p-wave state. The model is compared with recent experimental data from Cornell, DESY and SLAC. (auth)

46518 (ITEF-848) CONCERNING THE TWO-PHOTON MECHANISM OF PRODUCTION DURING COLLISION OF CHARGED PARTICLES. Terent'ev, M. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1971. 23p. (In Russian). Dep. NTIS (U. S. Sales Only).

The simple and invariant method of calculation with logarithmic precision of the asymptotic value of differential production cross section for charged particle collisions is formulated. The two-photon mechanism of production is considered. The main result is contained in given formulas. A number of examples is considered. The main features of the angular distributions and some numerical estimates are discussed considering the reaction of meson production as an example. (auth)

46519 (JINR-P2-6333) REACTION $\gamma + \gamma \to \pi + \pi$ AND ELECTROMAGNETIC DIFFERENCE FOR PION MASSES. Isaev, P. S.; Khleskov, V. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 26p. (In Russian). Dep. NTIS (U. S. Sales Only).

The reaction $\gamma + \gamma \to \pi + \pi$ was studied in the work by dispersion relations. The cross sections of the process were calculated for two parametrizations of s wave $\pi\pi$ phase shift. The dependence of cross sections on the threshold and high energy phase shift behavior and on inelasticity was investigated. The cross sections of the processes $e + e \to e + e + \pi + \pi$ were calculated. The pion electromagnetic mass was determined from dependence of the $\gamma + \gamma \to \pi^+ + \pi^-$ amplitude on photons "masses." (auth)

46520 (JINR-P2-6438) ELECTROMAGNETIC EFFECTS IN NUCLEON POLARIZATION AT MESON-NUCLEON SCATTERING. Vanzha, A. P.; Lapidus, L. I.; Tarasov, A. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 24p. (In Russian). Dep. NTIS (U. S. Sales Only).

It is shown, that at high energy and small t the contribution of electromagnetic interaction of particles with spin is of importance for polarization effects in elastic (and some inelastic) processes of hadrons. The investigation of polarization Po(t) and also Wolfenstein parameters A and R at small t gives the possibilities for experimental determination of real and imaginary parts of hadronic invariant amplitudes A and B. The electromagnetic contribution for A and B is obtained. When the amplitude A′ is involved, the expressions for the cross section, polarization P_0, R and A are given. The expression for A'_{em} is given. When both hadronic and electromagnetic amplitudes are considered simultaneously the question of relative phases of amplitudes becomes of interest. The estimations for t_m give relativistic generalization of Schwinger slow neutron scattering results. The Coulomb interaction, which is dominant at $|t| < |t_c|$, where t_c is given strongly reduces polarization effects when compared with the case of meson-neutron scattering. Electromagnetic effects give essential deviations at small t. For the numerical estimation of the scale of electromagnetic effects, approximate hadronic amplitudes were taken from Rarita et al. The results, which were obtained in this way, are illustrated. (auth)

46521 (LBL-773) FINAL STATE HADRON DISTRIBUTIONS AND GENERALIZED SCALING LAWS IN DEEP-INELASTIC ELECTROPRODUCTION PROCESSES. Pak, Namik K. (California Univ., Berkeley. Lawrence Berkeley Lab.). Apr 1972. Contract W-7405-eng-48. 93p. Dep. NTIS.

Thesis.

Processes of the type "electron + nucleon → electron + hadron (pion) + Anything" at high energy and high electron momentum transfer are discussed, via the processes "virtual photon + nucleon → hadron (pion) + Anything." New general scaling laws are obtained for these processes which contain hadronic scaling laws (limiting fragmentation, and pionization) and Bjorken scaling as special cases. The derivation is model independent and is based on the expansion of the forward three-to-three amplitude, "virtual photon + nucleon + hadron → virtual photon + nucleon + hadron," into O(1,2) harmonics. In getting the results it is assumed that the residue of pomeranchukon trajectory factorizes, and Bjorken scaling of the ordinary deep inelastic lepton scattering processes is used as an experimental fact. It is found that multiplicity of the produced particle grows with the energy logarithmically both

in the Regge and Bjorken scaling limits. Finally on the basis of PCAC hypothesis and the soft pion theorems of the current algebra the cross section of one soft pion production in deep inelastic electron scattering processes is calculated. (auth)

46522 (N-72-17763) CHARGED-PARTICLE MOTION IN THE VICINITY OF A NEUTRAL PLANE. Stern, David (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Feb 1972. 30p. (NASA-TM-X-65821; X-641-72-22). NTIS.

The motion of a charged particle in a 2-dimensional neutral sheet with linear magnetic field variation is analyzed by Hamiltonian methods. From the basic Hamiltonian formulation, results of Sonnerup are recovered and given intuitive interpretation. The transformed Hamiltonian is used to derive the correct frequency of oscillation and serves as the basis of analytical treatment of perturbed versions of the motion, e.g. with electric field added. For 2-dimensional fields with slightly differing configurations — in particular, with added small field component orthogonal to the sheet, with an X-type null or with a chain of null points — two alternative methods are developed, reducing the problem either to motion in a 2-dimensional potential or to a pair of coupled oscillators. (auth) (STAR)

46523 (NYO-4076-17) INELASTIC e-p SCATTERING AND THE POLARIZATION CONTRIBUTION TO H HYPERFINE STRUCTURE. Jensen, D.; Kovesi-Domokos, S.; Schonberg, E. (Johns Hopkins Univ., Baltimore, Md. Dept. of Physics). Jul 1971. Contract AT(30-1)-4076. 13p. Dep. NTIS.

The structure functions obtained from a specific resonance model of inelastic e-p scattering are used to evaluate the polarizability correction to the ground-state hyperfine splitting of hydrogen. By requiring that the spin-flip amplitude for real Compton scattering satisfy the Drell-Hearn sum rule, one can fix the only free parameter in the model. It is found that the polarizability corrections are approximately 1 ppm, in good agreement with the existing bounds on the uncertainty of Q. E. D. calculations of hyperfine structure. (auth)

46524 (NYO-4076-18) LIGHTLIKE QUARK MODEL AND CURRENT DENSITIES. Domokos, G. (Johns Hopkins Univ., Baltimore, Md. Dept. of Physics). Jul 1971. Contract AT(30-1)-4076. 23p. Dep. NTIS.

A field theory of quarks, with quark states being defined on space-time surfaces with lightlike normals, is formulated. The general structure of the field theory is discussed. It is found that single particle observables, and current densities in particular, have approximately a free field structure if the ground state is strongly degenerate. The structure functions of the nucleon in inelastic electron scattering exhibit a parton-like structure in any reference frame. (auth)

46525 (ORO-3992-80) LEPTONIC DECAY OF VECTOR MESONS IN AN ALGEBRAIC MODEL FOR HADRONS. Boehm, A. (Texas Univ., Austin. Center for Particle Theory). 4 Apr 1972. Contract AT(40-1)-3992. 25p. (CPT-134). Dep. NTIS.

The decay rates for $V \to e\bar{e}$ are calculated using an octet of transition operators that has been introduced previously in the framework of an algebraic model. The results are compared with experimental data and restrictions on the symmetry breaking relations for these transition operators are obtained, which are shown to be the analog of other well known symmetry breaking relations. (auth)

46526 (TPJU-14/71) COMPARISON OF THE ANGULAR DECAY DISTRIBUTIONS IN THREE QUARK MODELS OF PHOTOPRODUCTION. Gorczyca, Barbara (Jagellonian Univ., Krakow (Poland). Dept. of Theoretical Physics). Apr 1971. 11p. (CONF-710816-11). Dep. NTIS (U. S. Sales Only).

From International symposium on electron and photon interactions at high energies; Ithaca, N. Y. (23 Aug 1971).

The constraints for angular decay distributions of resonances photoproduced in the reactions $\gamma B \to PB^*$, $\gamma B \to VB$, and $\gamma B \to VB^*$ in the "excited quark" model and "interacting quarks" model, where the quark structure is assumed only for baryons, are derived and compared with the corresponding predictions of the usual additive quark model of photoproduction including vector meson dominance and the additivity assumption. All the results of the "interacting quarks" model can be derived from the "excited quark" model and all the results of the "excited quark" model can be derived from the additive quark model. (auth)

46527 $\rho^0 - \omega$ INTERFERENCE IN THE REACTIONS $\gamma \to \pi^+\pi^-\Delta$. Achasov, N. N.; Shestakov, G. N. (Inst. of Mathematics, Novosibirsk, USSR). JETP Lett. (USSR) (Engl. Transl.); 15: No. 7, 302-5(5 Apr 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 7, 427-30(5 Apr 1972).

Interactions in which the cross sections for ω production are much larger than those for ρ^0 production are expected to exhibit a considerable enhancement of the $\rho^0 - \omega$ interference. It is shown theoretically that the interference for interactions of the type $\gamma + N \to \pi^+ + \pi^- + \Delta$ is enhanced by a factor of 9 over that for $\gamma + A \to \pi^+ + \pi^- + A$ interactions. The general question of separating the nonresonant background processes in the study of quasi-two-particle interactions is also considered. (R.W.R.)

46528 INFORMATION ON THE PION ELECTROMAGNETIC FORM FACTOR INSIDE ITS ANALYTICITY REGION PROVIDED BY BOUNDS ON ITS MODULUS ON THE CUT ($t \geq 4m^2$). Raszillier, I. (Inst. of Physics, Bucharest). Commun. Math. Phys.; 26: No. 2, 121-9(1972).

A study is made of the mathematical aspects connected with the derivation of the model independent information that can be obtained on the pion electromagnetic form factor F(t) inside the analyticity region (the cut t-plane) from the knowledge of upper and lower bounds of its modulus on the cut $t \geq 4\ m^2$ using analyticity, reality, and the normalization $F(0) = 1$. It turns out that (in a certain sense) this information depends only on the upper bound, whereas the lower one is irrelevant. (auth)

46529 MESON PHOTOPRODUCTION IN THE BACKWARD DIRECTION. Greenhut, G. K. (Daresbury Nuclear Physics Lab., Eng.). Nucl. Phys.; B44: No. 2, 422-36(1972).

Two methods are discussed for predicting the cross sections for backward photoproduction of neutral mesons. One is an extension of the broken-SU(3) quark model plus vector dominance to the backward direction and yields cross sections for ρ^0, ω, and ϕ production. The other uses factorization of Regge residues correlating the Regge fits to $\pi N \to N\pi$, $\pi N \to N\rho$, $\pi N \to N\eta$, and $\gamma N \to N\pi$ to obtain predictions for the cross sections for ρ^0 and η photoproduction. (auth)

46530 DANGEROUS SCALING LIMIT FOR VIRTUAL COMPTON SCATTERING OFF THE FORWARD DIRECTION. Minkowski, P. (SIN, Zurich). Nucl. Phys.; B44: No. 2, 390-4 (1972).

Virtual Compton scattering off the forward direction is investigated in the scaling region. An example motivated by vector meson dominance is constructed in accordance with the Jost-Lehmann-Dyson representation which demonstrates that the light cone singularities of the current commutator fail to determine the amplitude if the square mass of one of the virtual photons remains finite. (auth)

46531 SOFT-PHOTON CROSS SECTIONS FOR $\pi^- d \to nn\gamma$. Picciotto, C. (Univ. of Victoria, B. C.). Can. J. Phys.; 50: No. 8, 798-802(15 Apr 1972).

A phenomenological calculation of cross sections for the reaction $\pi^- d \to nn\gamma$ for pion lab energies of 150 to 300 MeV is presented. (auth)

46532 INTERACTION OF AN INTENSE QUASI-MONOCHROMATIC ELECTROMAGNETIC BEAM WITH FREE ELECTRONS. Billoir, Pierre (Univ., Paris). Compt. Rend., Ser. B; 274: No. 15, 915-18(10 Apr 1972). (In French).

The effect of a coherent photon beam with a high photon density on electrons at rest was studied using a simple quantum model. In a first approximation, this interaction can be described in terms of the scattering of the electrons at right angles to the beam direction by using a statistical property of bosons; the effect is quadratic with respect to the number of photons. (France)

46533 DOMINANCE OF ELECTROMAGNETIC EFFECTS IN HIGH ENERGY HADRON AND PHOTON INDUCED REACTIONS. Dar, A. (Technion-Israel Inst. of Tech., Haifa). pp 17-38 of High Energy Phenomenology. /Tran Thanh Van, J. (ed.). Paris; Laboratoire de Physique Theorique et Hautes Energies (1971).

From Conference of Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971). See CONF-710345-(Vol.2).

Electromagnetic interactions in high energy hadron and photon induced reactions are examined. The one-photon exchange contribution to two-body final state reactions and also multibody final state reactions are discussed. The mechanism can be used for studying radiative decay rates of mesons, their elastic and inelastic form factors, and their structure functions and also for determining the phase of strong interaction amplitudes at high energy. Coulomb production in the nuclear field can explain the increase with energy observed in some recently reported inelastic cross sections. The dominance of the mechanism in the forward

direction can be used to measure radiative decay rates of mesons (Primakoff effect), and photon-meson and photon-photon cross sections. Interferences may lead to nonequality between particle and antiparticle cross sections. (France)

46534 K^+ PHOTOPRODUCTION. Capella, A. (Univ. Paris, Orsay, France). pp 289-97 of High Energy Phenomenology. /Tran Thanh Van, J. (ed.). Paris; Laboratoire de Physique Theorique et Hautes Energies (1971).

From Conference of Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971). See CONF-710345-(Vol.2).

K^+ photoproduction was studied with an incident momentum of the 5 to 15 GeV/c. Experimental data obtained exhibit the following features: a backward dip, but no dip in the $-0.4, -0.5$ $(GeV)^2$ region, below $2(GeV)^2$, K and K−p contributions giving α_{eff} approximately zero, a $d\sigma/dt(K\Sigma^0)/d\sigma/dt(K\Lambda)$ value approximately equal to 1 except in the forward direction. A model which considers only the K* and K** Regge poles and the K*−p and K**−p leading cuts is presented. (France)

46535 CONNECTIONS BETWEEN LOW ENERGY AND HIGH ENERGY K^+ PHOTOPRODUCTION. Renard, F. M. (Univ., Montpellier, France). pp 299-307 of High Energy Phenomenology. /Tran Thanh Van, J. (ed.). Paris; Laboratoire de Physique Theorique et Hautes Energies (1971).

From Conference of Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971). See CONF-710345-(Vol.2).

Characteristic features of the high energy $K^+\Lambda$ photoproduction are shown to appear also in the low energy region (1 to 2 GeV range). The low energy integral is examined, using the finite energy sum rules (FESR), over the imaginary part of the scattering amplitude. FESR integrals were separately calculated for the s-channel part (N*) and for the u-channel part (Y*) in the case of the four t-channel helicity amplitudes. Experimental features are shown to be remarkably consistent with the FESR integrals in the low energy region. (France)

46536 QUARK MODEL PREDICTIONS FOR ANGULAR DECAY DISTRIBUTIONS OF PHOTOPRODUCED VECTOR MESONS IN INCLUSIVE PROCESSES. Gorczyca, B. (Jagellonian Univ., Krakow). Lett. Nuovo Cim.; 4: No. 8, 291-4(24 Jun 1972).

The quark model predictions on the decay distribution of vector mesons produced by polarized photons in inclusive interactions are presented. Relations for statistical tensors are given, which can be checked experimentally using linearly and circularly polarized photons. (L.B.S.)

46537 FIXED-POLE AND VIRTUAL COMPTON AMPLITUDE. Ezawa, Z. F. (Tokyo Univ.). Lett. Nuovo Cim.; 4: No. 8, 315-19 (24 Jun 1972).

Fixed poles in the Compton scattering amplitude are investigated in a field theory with the parton description for the virtual Compton scattering in the Bjorken limit. (L.B.S.)

46538 HIGH-ENERGY ELECTROMAGNETIC PROCESSES IN CONDENSED MEDIA. Ter-Mikaelyan, M. L. Interscience Tracts on Physics and Astronomy, No. 29. New York; John Wiley and Sons, Inc. (1972). 466p. $27.50.

Coherent problems occurring in electromagnetic processes at high energies are examined from a unified viewpoint. The pseudo-photon method, coherent bremsstrahlung in a crystal, radiation processes at high energies in amorphous media, transition radiation, and radiation of particles passing uniformly through heterogeneous media are treated. (J.F.P.)

46539 DUALLY CHARGED PARTICLES AND DUAL INVARIANCE. Schiff, H. (Univ. of Alberta, Edmonton). Can. J. Phys.; 50: No. 11, 1062-7(1 Jun 1972).

Dual charges are introduced which differ essentially from the conventional (Dirac) magnetic monopoles. A natural vehicle is shown to be a dual invariant Lagrangian to represent observable charges; the dual invariance can be broken in a simple way by a class of dually charged objects which exhibit no electromagnetic interaction with observable dually charged particles. A triplet formulation can also be obtained and may be of interest in providing a basic description of bosons and fermions. (auth) (Canada)

46540 e^+e^- ANNIHILATION INTO HADRONS: RESONANCES, REGGE POLES, FIXED POLES, SCALING, AND DUALITY. Layssac, J.; Renard, F. M. (Department de Physique Mathematique, Montpellier, France). Nuovo Cim.; 10A: No. 3, 407-44 (1 Aug 1972).

The behavior of the cross section for $e^+e^- \to \pi^0 + \text{hadrons}$ is discussed through the following properties of the structure functions $W_1(q^2,\nu)$: low-energy theorem at $q^2 = 0$, vector-meson structures around $q^2 = m_\nu^2$, quasi-two-body contributions $\pi + R$ and $R + R'$ in the (1 to 2) GeV region, scaling Regge poles and fixed poles for high q^2. Duality relations are proposed in order to connect these different properties. The shapes of the differential and total cross sections are discussed with respect to the preliminary experimental results. (auth)

46541 INDUCED RADIATION FROM NEUTRONS MOVING THROUGH A MEDIUM IN A MAGNETIC FIELD. Kul'kin, A. G.; Pavlenko, Yu. G. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 83-7(1971). (In Russian).

The conditions for the formation of a negative coefficient of reabsorption were investigated for the system neutron beam-medium in the presence of a magnetic field. A coherent generation mechanism of electromagnetic waves in a broad range of frequencies was realized. (K.S.W.)

46542 ARE VECTOR POTENTIALS MEASURABLE QUANTITIES IN ELECTROMAGNETIC THEORY? Vigier, J. P.; Marcilhacy, G. (Institut Henri Poincare, Paris). Lett. Nuovo Cim.; 4: No. 13, 616-18(29 Jul 1972).

Starting from a realistic description of electromagnetic sources, it is shown (a) that one can define the measurable vector potentials A^μ even in Maxwell's theory, and (b) that these A^μ are just the limit for $m_\gamma \to 0$ of the A^μ of the De Broglie-Proca theory (L.B.S.)

46543 ACOPLANARITY AND RADIATIVE CORRECTIONS IN BHABHA SCATTERING. Calva-Tellez, E. (College de France, Paris); Kessler, P.; Parisi, J. Lett. Nuovo Cim.; 4: No. 13, 619-23(29 Jul 1972).

A recent experiment performed at the ADONE colliding-beam facility showed the occurrence of an appreciable number of acoplanar events in Bhabha scattering ($e^+e^- \to e^+e^-$). Acoplanar was defined as those events where the angle $|\varphi|$ between the two planes containing the beam axis and, respectively, the outgoing electron or positron was larger than 5°. These events were analyzed as being due to radiative corrections. Two distinct calculations are made in order to analyze the data in a more adequate way: an exact one, and a small-angle approximation, using the method of quasi-real processes. The acoplanarity distribution is shown to agree well with the experimental data. (L.B.S.)

46544 NONRELATIVISTIC HARMONIC-OSCILLATOR QUARK MODEL AND THE RATIO OF LONGITUDINAL TO TRANSVERSE CROSS-SECTIONS IN RESONANCE ELECTROPRODUCTION. Abdullah, T. (Dept. of Theoretical Physics, Oxford). Lett. Nuovo Cim.; 4: No. 13, 577-80(29 Jul 1972).

It is shown that the predictions of the nonrelativistic harmonic-oscillator quark model are essentially consistent with the results for the ratio of longitudinal to transverse cross sections in resonance electroproduction. It is pointed out that the predictions of the model are more sensitive to the choice of frame used for the physical interpretation of the matrix elements calculated than to the choice of parameters. The Breit frame is shown to be the most suitable frame for the nonrelativistic calculation. (L.B.S.)

46545 PHOTOPRODUCTION OF HYPERNUCLEI AND CURRENT ALGEBRA. Sidorov, A. A. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 53-5(1971). (In Russian).

The differential cross section of the reaction $\gamma + {}^3\text{He} \to K^+ + {}_\Lambda H^3$ was calculated within the limits of "soft" kaons, using the algebra of currents. In this reaction the nucleus ^{3}He and the hypernucleus ${}_\Lambda H^3$ are considered as elementary particles. The amplitude of the photo-formation process for hypernuclei could be combined with the matrix element of a weak hadron current between the nucleus-hypernucleus states so that they could be expressed by corresponding nuclear form factors. The coupling constant of the axial current which characterizes β decay of the ${}_\Lambda H^3$ may be equal to -0.67, as in the case of the free Λ-particle. (tr-auth)

46546 EFFECT OF THE COLLECTIVE INTERACTION OF PARTICLES ON THE LONGITUDINAL DIMENSIONS OF AN ELECTRON BUNDLE IN AN ACCUMULATOR. Grigor'ev, Yu. N.; Grishaev, I. A.; Naugol'nyi, N. N. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 16: No. 10, 1729-32(Oct 1971). (In Russian).

The effect of a force of collective interaction on the phase motion of relativistic electrons in a ring accumulator was studied. With an increase in the number of accumulated particles the decrement of synchrotron oscillations decreased, and the longitudinal dimensions of the bundle increased. The results of the theory are compared with experimental data on the latter phenomenon. (tr-auth)

46547 MOTION OF DIRAC PARTICLES POSSESSING AN ANOMALOUS MAGNETIC MOMENT IN A CENTRAL SYM-

METRIC ELECTRIC FIELD. Ternov, I. M.; Bagrov, V. G.; Bozrikov, P. V. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 38-45(1971). (In Russian).

States of a relativistic electron, having an anomalous magnetic moment, and moving in a central-symmetric field, were classified by a method which was very close to nonrelativistic classification. Spin quantum numbers are clearly distinguished. The motion of a neutron in a central field was also studied. New precise solutions for the Dirac-Pauli equations were found. A classical interpretation of the results is offered. (tr-auth)

46548 SPIN EFFECTS IN THEORY OF SYNCHROTRON RADIATION DUE TO MOTION OF AN ELECTRON IN A MEDIUM. Kul'kin, A. G.; Pavlenko, Yu. G. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 7-15(1971). (In Russian).

The presence of a medium essentially changes the known spin effects during ultra-luminous motion of an electron in a magnetic field. In particular, the ground state became unstable and the first excited state lost its metastable character. An expression was obtained for the lifetime of the ground and first excited states. The intensity of radiation of the two chief components of polarization was investigated as a function of spin orientation. (tr-auth)

46549 ELECTROPRODUCTION OF π MESONS NEAR THRESHOLD AND CURRENT ALGEBRA. Kulish, Yu. V. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 16: No. 9, 1437-43(Sep 1971). (In Russian).

The amplitudes of electroproduction of π-mesons near a threshold having no kinematic singularities are obtained by means of current algebra and PCAC. The sensitivity of the electroproduction cross section to the nucleon axial-vector form factor is indicated. (auth)

46550 PECULIARITIES IN INTERACTION OF HIGH-ENERGY ELECTRONS AND POSITRONS WITH CRYSTALS. Grishaev, I. A.; Efimov, V. P.; Kasulov, V. I.; (and others) (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 16: No. 9, 1548-50(Sep 1971). (In Russian).

The total yield of retarding photons was investigated as a function of crystal orientation during passage of electrons and protons with energies of 1 GeV through crystals of Si and Nb. The crystals were mounted so that the incident beam of electrons (positrons) penetrated in the direction of the axis ⟨110⟩ in the case of Si and ⟨100⟩ in the case of Nb. The crystal could be rotated around two perpendicular axes normal to the direction of the beam with a precision of 2×10^{-4} radians. The distinguishing parameter in the dependence of photon yield during the passage of electrons and protons through crystals was the width of the minimum in the region of small angles, which in the case of Si was 1.5 times smaller for positrons than for electrons; in the case of Nb was 1.6 times smaller for positrons than for electrons. (tr-auth)

46551 INDUCED EMISSION FROM AN ELECTRON IN A MAGNETIC FIELD AT THE LEVEL n = 1. Ternov, I. M.; Khalilov, V. R.; Zhuravlev, A. F.; Chizkov, G. A. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 97-100 (1971). (In Russian).

The influence of an external magnetic field wave on the polarization of an electron in a magnetic field was examined. Allowing for an anomalous magnetic moment of the electron, it is possible to obtain complete polarization of an electron beam in the state n = 0. (tr-auth)

46552 e^+e^- ANNIHILATION INTO TWO HADRONS IN THE ENERGY INTERVAL 1400 TO 2400 MeV. Alles-Borelli, V.; Bernardini, M.; Bollini, D.; (and others) (CERN, Geneva. Univ., Bologna. INFN, Bologna. INFN, Frascati, Italy). Phys. Lett.; 40B: No. 3, 433-6(10 Jul 1972).

The proof is given for the existence of the reaction $e^+e^- \rightarrow h^\pm h^\mp$ in the energy range 1400 to 2400 MeV, and its energy dependence is compared with that of $e^+e^- \rightarrow e^\pm e^\mp$, in the same experimental conditions of observation. The exponent of the s-dependence of the ratio $\alpha = (e^+e^- \rightarrow h^\pm h^\mp)/(e^+e^- \rightarrow e^\pm e^\mp)$ is measured to be $n = 2.08 \pm 0.45$, in the s-range $(1.96-5.76)$ GeV^2, on the basis of 51 $e^+e^- \rightarrow h^\pm h^\mp$ events and 8918 $e^+e^- \rightarrow e^\pm e^\mp$ events observed. (auth)

46553 DRELL-HEARN SUM RULE AND THE LEPTON MAGNETIC MOMENT IN THE WEINBERG MODEL OF WEAK AND ELECTROMAGNETIC INTERACTIONS. Altarelli, G. (Univ., Rome); Cabibbo, N.; Maiani, L. Phys. Lett.; 40B: No. 3, 415-19 (10 Jul 1972).

It is verified that the fourth-order Compton amplitude for the scattering of a photon off a charged lepton is finite in Weinberg's model of weak and electromagnetic interactions, and obeys the Drell-Hearn sum rule. The second-order weak corrections to the anomalous magnetic moment of a charged lepton in the same model is computed. For the case of the muon, the following bounds are found: $+0.2 \times 10^{-8} \leq \kappa \leq +0.56 \times 10^{-8}$. (auth)

46554 NUCLEON FORM FACTORS IN A FIELD THEORY ON A HOMOGENEOUS SPACE OF THE POINCARE GROUPS. Brink, L.; Marnelius, R. (Inst. of Theoretical Physics, Goteborg). Nuovo Cim.; 10A: No. 3, 533-59(1 Aug 1972).

The nucleon form factors are calculated to lowest order in a new field theory on an 8-dimensional homogeneous space of the Poincaré group. The simplest diagram does give both an electric and a magnetic form factor and a relation between them. It seems, however, difficult to reproduce the experimental data, as, e.g., any anomalous magnetic moment does not appear in a natural way. (auth)

46555 PHOTOPRODUCTION OF RHO-MESONS ON DEUTERONS. Wilk, G. (International Centre for Theoretical Physics, Trieste, Italy). Nuovo Cim.; 10A: No. 2, 207-29 (21 Jul 1972).

A formalism for $V_1 + D \rightarrow V_2 + D$, where $V_{1,2}$ are 1^- particles, is presented using the Glauber-model approach. The scattering amplitude is built up from $V_1 + N \rightarrow V_2 + N$ amplitudes treating the nucleons as spinless particles. Spin and D-state in the deuteron is taken into account in the usual manner. The formalism is applied to describe the photoproduction of rho-mesons on deuterons and comparison with experimental data is made. Some predictions on the density matrix elements of outgoing rho in terms of the rho-nucleon amplitude are given. It is shown that exact measurements of these can give information about spin structure of the rho-nucleon amplitude. (auth)

46556 CANONICAL ANOMALIES AND BROKEN SCALE INVARIANCE. Chanowitz, M. S.; Ellis, J. (Stanford Univ., Calif.). Phys. Lett.; 40B: No. 3, 397-400(10 Jul 1972).

Canonical behavior of strong interactions at short distances causes an anomaly in the trace identity involving two electromagnetic currents and the energy-momentum tensor. The anomaly is connected with the high energy behavior of $e^+e^- \rightarrow \gamma \rightarrow$ hadrons and the $\epsilon(700)\gamma\gamma$ coupling constant. (auth)

46557 t-DEPENDENCE OF THE FORM FACTORS OF THE NUCLEONS AND THE COMPOSITENESS OF THE ρ-MESON. Bordes, G. (College de France, Paris). Lett. Nuovo Cim.; 4: No. 9, 362-4(1 Jul 1972).

Magnetic and electric isovector form factors of the nucleon are calculated in the range of spacelike and low four-momentum transfer $0 < t < 1$ (GeV/c)^2. (L.B.S.)

46558 SCALING AND FINITE ELECTROMAGNETIC SELF-MASS OF HADRONS. Morita, K. (Dalhousie Univ., Halifax, Nova Scotia). Lett. Nuovo Cim.; 4: No. 9, 385-8(1 Jul 1972).

The general conditions to guarantee the finiteness of the electromagnetic self-mass of hadrons are derived under certain assumptions for scaling behavior, Regge behavior with scaling, and analyticity. (L.B.S.)

46559 DUALITY, SCALING, AND FIXED POLES IN VIRTUAL COMPTON SCATTERING. Miranskii, V. A.; Shelest, V. P.; Zinov'ev, G. M. (Inst. for Theoretical Physics, Kiev). Nucl. Phys.; B44: No. 2, 460-74(1972).

J-plane fixed poles are considered in the lepton-hadron scattering amplitudes. A relation between the scale-invariant behavior of the virtual Compton scattering structure W_2 and the J = 1 pole is established using the wrong signature FESR. A dual mechanism for the generation of fixed poles, leading to a number of interesting implications for a singular behavior of the pole residue in the variable q^2 (photon mass square), is indicated. (auth)

46560 KINEMATICS OF THE COUPLING OF REGGE POLES TO PHOTONS. Collins, P. D. B.; Gault, F. D. (Univ. of Durham, Eng.). Nuovo Cim.; 10A: No. 2, 189-206(21 Jul 1972).

Two problems which arise in understanding Regge-pole exchange in amplitudes which include photons are examined; namely how there can be a pion-exchange pole in pion photoproduction, and a finite pomeron coupling in forward Compton scattering. An attempt is made to resolve these problems by noting that the usual sense-nonsense zeros, which might seem to make the couplings vanish, can in fact be replaced in the partial-wave amplitudes by zeros in the kinematical factors. Since the zeros are absent from the total amplitudes, finite couplings remain. This replacement is a peculiarity of photon couplings. It has the disadvantage of changing the threshold behavior of the partial-wave amplitudes, but seems to be the only plausible way out of the dilemma. There are no other special requirements of gauge invariance, so that

these photon-induced processes may be Reggeized in exactly the same way as purely hadronic reactions. (auth)

46561 PION FORM FACTOR AND POSSIBLE HEAVY VECTOR MESON. Furuichi, Susumu (Rikkyo Univ., Tokyo); Kanada, Hiroyuki; Watanabe, Keiji. Progr. Theor. Phys. (Kyoto); 47: No. 5, 1790-2(May 1972).

The pion form factor is investigated for large t ($t > 1$ $(GeV/c)^2$) for space-like and time-like region on the basis of a simple pole with ρ-meson dominance. It is shown that contributions from an additional pole ρ' greatly improve the fit to the experimental data for the space-like region. (L.B.S.)

46562 PARITY TESTS IN ELASTIC e-p SCATTERING AT LARGE ANGLES. Kuroda, Masaaki; Yamaguchi, Yoshio (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 47: No. 5, 1676-81(May 1972).

The possibility of parity violation in elastic e-p scattering in large momentum transfer regions is discussed. (auth)

46563 PHOTOPRODUCTION OF VECTOR AND AXIAL VECTOR RESONANCES IN BROKEN NONLINEAR CHIRAL $SU_3 \times SU_3$ DYNAMICS. Kelemen, V. I.; Sabo, V. I.; Sosnivker, W. A.; Egorov, A. V. (Inst. of Theoretical Physics, Moscow). Lett. Nuovo Cim.; 4: No. 10, 401-6(8 Jul 1972).

The differential cross sections of photoproductions of all vector and all pseudoscalar resonances on baryons N and E are calculated within the framework of broken nonlinear chiral $SU(3) \times SU(3)$ dynamics, and are compared with the predictions of the dispersion approach and with the available experimental data. (L.B.S.)

46564 SIMPLE DIFFRACTION CONSIDERATIONS AND RELATIONS BETWEEN σ_T AND SLOPE OF VECTOR MESON ELECTROPRODUCTION. Eisenberg, Y. (Stanford Univ., Calif.). Lett. Nuovo Cim.; 4: No. 10, 425-9(8 Jul 1972).

The (ν, q^2) dependence of the total cross section for $\gamma_v + p \rightarrow \rho^o + p$ is examined in the framework of the geometric diffraction picture. The behavior of the cross section in the Bjorken limit (ν and $q^2 \rightarrow \infty$ and finite ratio ν/q^2) is also examined. It is concluded that this picture relates in a simple way the observed decrease of the slope B with q^2 to the scaling mechanism and seems to agree with present experimental data. It is also predicted that in the Bjorken limit B would go to zero like $\sim 1/q^2$ if ϵ remains constant, or that $(1-\epsilon) \sim 1/q^2$ with $B \rightarrow$ constant. (L.B.S.)

46565 DEEP INELASTIC SCATTERING, SCALING, AND REGGE BEHAVIOR IN A FEYNMAN DIAGRAM MODEL. Ahmed, M. A. (Univ. of Khartoum, Sudan). Progr. Theor. Phys. (Kyoto); 47: No. 5, 1610-18(May 1972).

The Regge and scaling behavior of the scattering amplitude of massive photons on nucleons are investigated within the context of the dynamical Van Hove-type of model. The correct Regge behavior is obtained but the conventional formulation of the model does not exhibit scaling. The reason for this is pointed out and a cure that restores scaling is given. (auth)

46566 CHARGE DISTRIBUTIONS OF PARTONS AND SCALING IN DEEP INELASTIC SCATTERING. Chowdhury, A. Roy; Chowdhury, R. K. Roy (Jadavpur Univ., Calcutta). Progr. Theor. Phys. (Kyoto); 47: No. 5, 1619-23(May 1972).

A charge distribution of partons inside the proton is conjectured. On this basis νW_2 is calculated in parton model for high energy inelastic scattering. Scaling behavior of νW_2 is reproduced and agrees fairly well with the experimental data. The predicted value of the mean square charge per parton is also lower than that obtained previously. (auth)

46567 SPECIAL METHOD IN S-MATRIX THEORY WITH THE p^4 MOMENTUM REPRESENTATION. Borelowski, Z.; Brzezowski, S. (Jagellonian Univ., Krakow). Acta Phys. Pol.; B3: No. 3, 363-73(1972).

A regularization method in the Kadyshevsky momentum representation for the boson-boson and boson-photon interactions is applied. (auth)

46568 DIRAC-HESTENES EQUATION AND THE MAXWELL EQUATIONS. Boudet, Roger (Univ., Aix-Marseille). Compt. Rend., Ser. A; 274: No. 16, 1278-80(17 Apr 1972). (In French).

The fusion method is applied to the Hestenes equation. Equations are obtained which are essentially real. (France)

46569 COMPARISON OF THE ANGULAR DECAY DISTRIBUTIONS IN THREE QUARK MODELS OF PHOTOPRODUCTION. Gorczyca, B. (Jagellonian Univ., Krakow). Acta Phys. Pol.; B3: No. 3, 391-6(1972).

The constraints for angular decay distributions of resonances photoproduced in the reactions $\gamma B \rightarrow PB^*$, $\gamma B \rightarrow VB$, and $\gamma B \rightarrow VB^*$ in the "excited quark" model and the "interacting quarks" model, where quark structure is assumed only for baryons, are derived and compared with the corresponding predictions of the usual additive quark model of photoproduction including vector meson dominance and the additivity assumption. All the results of the "interacting quarks" model can be derived from the "excited quark" model and all the results of the "excited quark" model can be derived from the additive quark model. (auth)

Weak

46570 (IC-72/54) VIRTUAL NEUTRINO EFFECTS. Budini, P. (International Centre for Theoretical Physics, Trieste (Italy)). Jun 1972. 14p. Dep. NTIS (U. S. Sales Only).

It is shown that the attractive forces due to exchange of neutrino pairs between leptons and antileptons are of such a nature that, if their long-range x^{-6} behavior continues up to distances of the order $G_F^{\frac{1}{2}}$, they are apt to give massless composite lepton-antilepton states. These states could only have spin-one and they would presumably be medium strongly bound to free leptons. Possible consequences are discussed. (auth)

46571 (KFKI-72-15) SPONTANEOUS DECAY IN A TIME DEPENDENT EXTERNAL FIELD. Hrasko, P. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). [ndl. 11p. Dep. NTIS (U. S. Sales Only).

The parametric resonance in the decay of a system such as a positronium is discussed. It is shown, using Wigner-Weisskopf perturbation theory, that the decay constants depend on the frequency of the external perturbation. (auth)

46572 INTERPRETATION OF EXPERIMENTS ON THE SEARCHES FOR THE $K_S \rightarrow 2\mu$ DECAY. Dolgov, A. D.; Zakharov, V. I.; Okun, L. B. (Inst. of Theoretical and Experimental Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 15: No. y, 308-10(5 Apr 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 7, 434-7(5 Apr 1972).

In connection with the contradiction between the results of experiments on the decays $K_L \rightarrow 2\mu$ and $K_L \rightarrow 2\gamma$, it has been proposed that the suppression of the $K_L \rightarrow 2\mu$ decay is due to destructive interference of the $K_2 \rightarrow 2\mu$ and $K_1 \rightarrow 2\mu$ transitions. In this case the width for the $K_S \rightarrow 2\mu$ decay should be relatively large, the lower limit for the width being attainable only in the presence of a strong $2\pi - 2\mu$ interaction. The possibility that this interaction is CP noninvariant is discussed, and the limitations imposed on the width of the $K_S \rightarrow 2\mu$ decay are analyzed under different hypotheses concerning the anomalous interactions of muons, photons, and pions. (R.W.R.)

46573 LIMITATIONS ON CURRENTS OF THE SECOND CLASS IN THE PROCESS $\nu_\mu + n \rightarrow p + \mu^-$. Lobov, G. A. JETP Lett. (USSR) (Engl. Transl.); 15: No. 6, 253-5(20 Mar 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 6, 357-9(20 Mar 1972).

An upper bound is obtained for the tensor component of the second-class current in the process $\nu_\mu + n \rightarrow p + \mu^-$ from experimental data on the total cross section. (L.B.S.)

46574 PARTONS MAY HAVE INTEGRAL CHARGE. Budny, R.; Chang, T. H.; Choudhury, D. K. (Oxford Univ.). Nucl. Phys.; B44: No. 2, 618-28(1972).

Two parton models are presented for partons having the quantum number of the three triplet models proposed by Han and Nambu and by Cabibbo, Maiani and Preparata. Predictions of deep-inelastic lepton scattering are made and compared with experiment. The former model fares as well as the quark parton model, but the latter model is less successful. (auth)

46575 BOUNDS FOR K_{l3} DECAY PARAMETERS. Micu, M. (Inst. for Atomic Physics, Bucharest. Joint Inst. for Nuclear Research, Dubna). Nucl. Phys.; B44: No. 2, 531-40(1972).

The extremum of the integral $\int_1^\infty f(x)|F(x)|^2\,dx$ is determined for the case when the values taken by the function F(x) at three points are known. The result is applied to the K_{l3} problem, the function F(x) being replaced by the form factor $f_+(q^2) + f_-(q^2)q^2/(m_K^2 - m_\pi^2)$ of the divergence of the strangeness changing vector current. (auth)

46576 RADIATIVE CORRECTIONS TO MUON DECAY. Ross, D. A. (Oxford Univ.). Nuovo Cim.; 10A: No. 3, 475-89(1 Aug 1972).

The radiative correction to the decay rate of the muon is considered. Particular attention is paid to the cancellation of the infrared divergences. The parts of the radiative correction which lead to these divergences are summed to all orders in the fine-

structure constant, whereas the rest of the correction is calculated to first order only. The result is convergent for all electron energies including the high-energy end point which diverged in previous first-order calculations. (auth)

46577 TESTS FOR A POSSIBLE CLASS OF CP INVARIANT SOLUTIONS TO THE $K_L \rightarrow \mu\bar{\mu}$ PROBLEM. Alles, W. (Univ., Bologna. Istituto Nazionale di Fisica Nucleare, Bologna); Pati, J. C. Nuovo Cim.; 10A: No. 2, 325-42(21 Jul 1972).

The possibility that the unitarity sum for the absorptive part of the $K_L \rightarrow \mu\bar{\mu}$ amplitude receives contribution in a CP-invariant manner from an on-mass-shell intermediate state involving a yet undetected light neutral boson (χ^0) is considered. It is suggested that the most relevant intermediate state is the ($\chi^0\gamma$) state with χ^0 having spin-parity I^-. It is pointed out that the existence of such a particle, if it is not already excluded by present experiments, can be tested unambiguously and relatively easily by two experiments: (a) the measurement of the rate of the $K_L \rightarrow \chi^0 + \gamma$ decay (the χ^0 may be looked for easily via its decays to (e^-e^+) and ($\mu^-\mu^+$) systems), and (b) the production of the χ^0 by low-invariant-mass (e^-e^+) colliding-beam experiments. It is noted that the χ^0, if it exists, receives a "natural" interpretation only in framework of hadron symmetries higher than the familiar SU_3-group. The production of χ^0 by a host of production and decay processes is discussed subject to such an interpretation. (auth)

46578 LEPTON CHARGE AND WEAK NEUTRINO–LEPTON INTERACTION. Romanov, Yu. I. Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 30-4(1971). (In Russian).

It was postulated that a system of leptons is characterized by one lepton charge with different magnitudes for μ-leptons and e-leptons. Within the framework of this scheme weak neutrino-lepton interactions were studied. "Charged" (V – A)-currents were introduced in order to describe $\tilde{\nu}_e \rightleftharpoons \nu_\mu$ and $\tilde{\nu}_\mu \rightleftharpoons \nu_e$ transitions. (tr-auth)

46579 INTERACTION PROCESSES OF NONZERO REST MASS ν AND $\bar{\nu}$ WITH LEPTONS. Rekalo, A. P. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 16: No. 10, 1585-92(Oct 1971). (In Russian).

Expressions for the differential and total cross sections of different processes of nonzero mass neutrino interaction with leptons are obtained in terms of invariant variables. The relations correct for $m_\nu = 0$ and $m_\nu \neq 0$, between the cross sections of lepton weak processes are found. The energy dependence of the energy loss and the scattering angle of ν and $\bar{\nu}$ in νe and $\bar{\nu}e$ scattering are analyzed in detail. (auth)

46580 $\Delta = \frac{1}{2}$ RULE IN THE THREE-TRIPLET AND PARAQUARK MODELS. Kingsley, R. L. (Cambridge Univ., Eng.). Phys. Lett.; 40B: No. 3, 387-91(10 Jul 1972).

It is possible to propose a charged weak interaction current which will generate a non-leptonic weak Hamiltonian satisfying the $\Delta I = \frac{1}{2}$ rule in the models of three triplets with integral charges, but not in the paraquark model. (auth)

46581 QUASI-ELASTIC NEUTRINO REACTION IN DEUTERIUM. Bernabeu, J.; Pascual, P. (Univ. of Valencia). Nuovo Cim.; 10A: No. 1, 61-75(1 Jul 1972).

The process $\nu + d \rightarrow \mu^- + p + p$ is studied in the framework of the impulse approximation, with or without using closure approximation. Final-state interactions are considered. (auth)

46582 ELECTROMAGNETIC DIVERGENCES IN WEAK PROCESSES. Bailin, D. (Univ. of Sussex, Eng.). Nuovo Cim.; 10A: No. 1, 159-72(1 Jul 1972).

Earlier calculations of the leading divergence in weak transitions between hadrons are generalized by including the electromagnetic interactions of the hadrons and of the charged W-boson. It is found that these can be removed by a self-mass counter term having the same form as that found earlier. However, there is an additional counter term in which the hadrons, in the form of the neutral Cabibbo current, are coupled directly to the electromagnetic field. (auth)

46583 K_{l3}-DECAY PARAMETERS AND POSSIBLE SCALAR COUPLING IN WEAK INTERACTIONS OF URBARYONS. Kaneko, T. (Meijo Univ., Nagoya, Japan). Lett. Nuovo Cim.; 4: No. 9, 373-6(1 Jul 1972).

The K_{l3} decay is discussed under the assumption of possible existence of scalar coupling in the weak interactions of urbaryon. It is pointed out that under this assumption, the relation of the scalar form factor to the Callan–Treiman relation can be understood. (L.B.S.)

46584 NEUTRINO REACTIONS AT ACCELERATOR ENERGIES. Smith, C. H. Llewellyn (Stanford Univ., Calif.). Phys. Rep.; 3C: No. 5, 261-379(Jun 1972).

Possible investigations of the properties of weak interactions using high energy neutrinos are reviewed. The use of neutrinos to probe hadron structure is discussed. (auth)

46585 MIXING PARAMETER ϵ IN NEUTRAL K DECAY. Ito, Yukio (Fukushima Univ., Japan). Progr. Theor. Phys. (Kyoto); 47: No. 5, 1777-8(May 1972).

An explicit formula between the mixing parameter ϵ and γ_1, γ_2, Δm ($= m_1 - m_2$) of K_1 and K_2 in superweak theory was previously shown by Kenny and Kabir (Phys. Rev. D2; 257(1970)). It is shown that the relation obtained by Kenny and Kabir holds in the general frame of Wu and Yang's theory without assuming $A_\alpha = \mathrm{Re}A_\alpha$. (L.B.S.)

Strong (General)

Refer also to abstracts: 46462, 46683, and 46686.

46586 (JINR–P2-6501) FEYNMAN–WILSON-GAS MODEL AS A CONSEQUENCE OF JET APPROACH TO INELASTIC HADRON PROCESSES. Dushutin, N. K.; Mal'tsev, V. M.; Sheptii, V. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 14p. (In Russian). Dep. NTIS (U. S. Sales Only).

A possibility is shown to formulate the Feynman-gas model as a consequence of the jet approach to the process of deep-inelastic hadron interactions. The sense of the correlation functions, included into the model, is clarified. The further trends of the model generalization are shown. (auth)

46587 (RLO–2230-T-4-1) TESTS OF HIGH-ENERGY MODELS BY TWO-PARTICLE ANALYSES. Hwa, Rudolph C. (Oregon Univ., Eugene). 1972. Contract AT(45-1)-2230. 12p. Dep. NTIS.

Two-particle distribution functions are calculated in the diffractive-excitation model and compared with those of the multiperipheral model. Optimum regions for differentiating the predictions of the models are indicated. Decisive, yet feasible, experimental tests are suggested. (auth)

46588 POSSIBLE EXISTENCE OF HADRONIC ISOMERS. Pontecorvo, B. (Joint Inst. of Nuclear Research, Dubna, USSR). JETP Lett. (USSR) (Engl. Transl.); 15: No. 6, 250-3(20 Mar 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 6, 353-6(20 Mar 1972).

It is pointed out that, owing to the uncertainty relation, an examination of the angular momenta reveals a unique simularity between quantum objects that differ strongly in their scales and in their mean energy distances between excitation levels. The question of possible metastability connected with large values of J in the field of hadron physics analogous to nuclear isomerism is considered. Experiments aimed at searching for hadronic isomers are discussed. (L.B.S.)

46589 WAVE PACKET REALIZATION OF LIGHTLIKE STATES. Domokos, G. (Johns Hopkins Univ., Baltimore). Commun. Math. Phys.; 26: No. 1, 15-23(1972).

A new realization of lightlike particle states is constructed. The realization considered corresponds to objects which form partially localized wave packets in the space dimensions transverse to the direction of the lightlike momentum. The states of the transverse motion are classified by the representations of an algebra SU(1,1) constructed of the generators of the conformal group. It is conjectured that this realization is suitable for the formulation of the "parton"-model of hadrons. (auth)

46590 HIGH ENERGY PHENOMENOLOGY. Proceedings of the Second Session of the Sixth Rencontre de Moriond, Meribeles-Allues, France, March 7–9, 1971. Tran Thanh Van, J. (ed.). Paris; Laboratoire de Physique Theorique et Hautes Energies (1971). 559p. (In French and English). (CONF-710345-(Vol.2)).

There were 28 papers on high energy strong interaction phenomenology presented. Separate abstracts were prepared for 27 of these papers, the remaining paper having been published in abstract form. (France)

For abstracts of individual papers see: 46436–46438, 46462–46465, 46488–46492, 46533–46435, 46591, 46592, and 46627–46636.

46591 LARGE ANGLE SCATTERING OF HADRONS. Krzywicki, A. (Univ. Paris, Orsay, France). pp 187-211 of High Energy Phenomenology. /Tran Thanh Van, J. (ed.). Paris; Laboratoire de Physique Theorique et Hautes Energies (1971).

From Conference of Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971). See CONF-710345-(Vol. 2).

Large angle elastic scattering of hadrons at high energy is discussed (a few GeV). Experimental data are briefly surveyed and the various theoretical models applying to the elastic case are presented: small angle scattering models extended to large angles, and the statistical model. (France)

46592 EXCHANGE DEGENERACY AND DIP MECHANISMS IN HIGH ENERGY COLLISIONS. Tran Thanh Van, J. (Univ. Paris, Orsay, France). pp 485-525 of High Energy Phenomenology. /Tran Thanh Van, J. (ed.). Paris; Laboratoire de Physique Theorique et Hautes Energies (1971).

From Conference of Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971). See CONF-710345-(Vol.2).

Exchange degeneracy in high energy collisions is envisaged. It is shown to be verified for ρ-A_2 and K^*-K^{**} in the reactions with small Regge cuts. The two classes of high energy models which are essentially characterized by the presence or absence of nonsense wrong signature zeros are also discussed. Two crucial tests of the different models are presented: measurement of ρ^z_{00} in $\pi^+n \to \omega p$ or $\pi^-p \to \omega n$, precise measurement of the $\pi^-p \to \eta n$ differential cross section at very small t as well as at large t. (France)

46593 ATTEMPT AT GENERALIZING DUAL-RESONANCE MODELS. A GROUP-THEORETICAL APPROACH. Matsumoto, H. (Tokyo Univ.). Nuovo Cim.; 10A: No. 3, 445-67(1 Aug 1972).

Generalizations of dual-resonance models are discussed within the context of the group-theoretical formulation of the theory. Fields irreducible under $SL_{2,R}$ transformations are introduced, which are closely related to the $SL_{2,C}$ irreducible ones. The scheme has a simple factorization property and is convenient to see resonance structures. To satisfy the cyclic symmetry, three types of constructions of vertices are discussed. Gauge properties are also investigated in a model-independent way. It is shown that the Virasoro's general gauge is realized only for fields with the $SL_{2,R}$ spin 0, $-\frac{1}{2}$ and -1. In the light of these results, it is concluded that the general gauge and realistic models ($\alpha_p(0) = \frac{1}{2}$) are incompatible in additive models. (auth)

46594 DYNAMIC INTERPRETATION OF BARYON AND MESON MASS FORMULAE. Libby, L. M. (Univ. of California, Los Angeles). Phys. Lett.; 40B: No. 3, 307-10(10 Jul 1972).

A dynamical interpretation of baryon and meson mass formulae offers an explanation for associated production, for parity nonconservation, and for the $T = \frac{1}{2}$ rule. (auth)

46595 POLARIZATION IN INCLUSIVE REACTIONS. Kuroda, M.; Oyanagi, Y. (Tokyo Univ.). Lett. Nuovo Cim.; 4: No. 13, 627-30(29 Jul 1972).

Polarization in hadronic inclusive interactions is examined and expressions are obtained for the asymmetry in the fragmentation region and in the triple-Regge region. The asymmetry of photo-induced inclusive interactions is briefly examined. (L.B.S.)

46596 DERIVATION OF THE CRITICAL TEMPERATURE FOR THE SUPERFLUID PHASE OF HADRONIC MATTER. Mann, A.; Weiner, R. (Indiana Univ., Bloomington). Phys. Lett.; 40B: No. 3, 383-6(10 Jul 1972).

A quantitative derivation is given of the temperature at which superfluidity of hadronic matter ends. Using considerations similar to those used by Landau for ^{4}He, $T_c \leq 190$ MeV is found in close agreement with Hagedorn's "limiting" temperature. (auth)

46597 SOME CONSEQUENCES OF THE VANISHING OF THE TRIPLE-POMERONCHUKON-VERTEX. Rajaraman, R. (Cornell Univ., Ithaca, N. Y.). Phys. Lett.; 40B: No. 3, 392-6(10 Jul 1972).

Starting with the assumption that the triple-pomeronchukon-vertex vanishes when all three pomeronchukons have zero mass, it is shown that in the absence of pionization, total cross sections would fall at least logarithmically with energy, while the mean multiplicity would approach a constant. Several reasons are presented to suggest that some pionization must occur and that, otherwise, limiting fragmentation itself would vanish. A secondary result, that the P-P-P′ coupling will also vanish in certain regions, is also proved. (auth)

46598 POSSIBLE BOUNDS ON MUON PAIR AND $W^\pm$ PRODUCTION IN SUPER-HIGH-ENERGY HADRON COLLISIONS. Mikamo, S. (Tokyo Univ.). Nuovo Cim.; 10A: No. 2, 303-10 (21 Jul 1972).

Possible bounds on the muon pair and $W^\pm$ production cross sections in high-energy hadron collisions are discussed in connection with a theory predicting cross sections linearly rising with the incident-proton energy for both cases. It is pointed out that the cross sections do not seem to exceed the order of 10 μb up to several hundred TeV proton energies from the observation of the steeply falling spectrum of cosmic-ray muons where the energetic muons produced forward from such muon sources are expected to flatten the spectrum. (auth)

46599 PARTON MODEL AND THE CONCEPT OF DUALITY IN STRONG INTERACTIONS. Bandyopadhyay, P. (Indian Statistical Inst., Calcutta); De, S. S. Lett. Nuovo Cim.; 4: No. 9, 377-80(1 Jul 1972).

It is shown that the concept of duality can be incorporated into the framework of the parton model of hadrons from the dynamics of strong interactions. The various strongly interacting processes are generalized by arguing that all baryons as well as K-meson contain a π-meson in their structure and the specific interaction can be represented in terms of the pion-pion interaction and the corresponding rearrangement of partons. The $\pi N \to \pi N$ and $\Delta\bar{\Delta}$ interactions are considered as examples. (L.B.S.)

46600 DUALITY PROPERTIES OF REGGE CUTS. Collins, P. D. B.; Hutt, P. K. (University Science Labs., Durham, Eng.). Lett. Nuovo Cim.; 4: No. 9, 347-51(1 Jul 1972).

It is shown that quark-parton duality diagrams give a convenient mnemonic for the internal-symmetry and duality properties of Regge cuts. (L.B.S.)

46601 PHOTONLIKE PARTICLES, COMPTON SCATTERING, AND SUM RULES IN THE DUAL-RESONANCE MODEL. Friedman, K. A.; Rosenzweig, C. (Massachusetts Inst. of Tech., Cambridge). Nuovo Cim.; 10A: No. 1, 53-60(1 Jul 1972).

An analogy is drawn between the real photons appearing in electrodynamics and the photonlike particle appearing in the dual-resonance model with unit intercept. Sum rules for the Compton scattering of these particles are derived and, by employing the analogy, interpreted in terms of low-energy theorems. In particular the "universal" property of magnetic moments and the lack of anomalous moments in the dual model are redevised. It is also shown that the Beg-type sum rule exists and is saturated by relatively few states. This is a direct result of the simplicity of the collinear algebra appearing in the dual model. (auth)

46602 SELF-CONSISTENT DIFFRACTION IN THE MULTIPERIPHERAL MODEL. Ball, J. S.; Zachariasen, F. (California Inst. of Tech., Pasadena). Phys. Lett.; 40B: No. 3, 411-14(10 Jul 1972).

An exact self-consistent solution, for small t and very large s, of the multiperipheral bootstrap equations is presented. The solution predicts that total cross sections grow like log s, that elastic total cross sections are constant, that elastic diffraction peaks shrink like $(\log s)^2$, and that multiplicities grow like log s, all in the limit of infinite s. (auth)

46603 SPACE-TIME DESCRIPTION OF HADRONS. Mansouri, Freydoon. Baltimore; Johns Hopkins Univ. (1969). 134p. University Microfilms Order No. 72-16,839.

Thesis.

The possibility of a consistent space-time description of hadrons is investigated. It is assumed that to zeroth approximation the amplitudes and propagators transform according to the irreducible representations of the proper complex Lorentz group, $L_+(C)$, or its covering group $SL(2,C) \otimes SL(2,C)$. To have both Lorentz covariance and Regge behavior, it becomes necessary to work in a realization of the representations of SL(2,C) which is insensitive to the little group structure of the Poincare group. Amplitudes and propagators are constructed for free hadrons. The behavior of hadron amplitudes under C, P, and T is worked out. It is shown, moreover, that these amplitudes have definite transformation properties under fermion number and chiral gauge transformations, which determine the Toller quantum number, M. In particular, it is found that both fermions and mesons form chiral doublets. Explicit expressions for $M = 0$ and $M = \pm\frac{1}{2}$ propagators are given. They depend on one unknown parameter: The Lorentz trajectory of the corresponding hadron. To describe the interactions of hadrons, the structure of vertices is investigated. It is found that in general they are quasilocal. The knowledge of wave functions, propagators, and vertex functions lead to a set of simple diagram rules for the construction of the invariant scattering amplitudes. The application of the diagram rules to meson–

meson scattering processes with a single exchange reproduces the well known contributions of the corresponding Lorentz poles with rapidly converging residues. (Diss. Abstr. Int., B)

46604 DOES THE SIMPLE QUARK LIGHT-CONE CURRENT ALGEBRA OF FRITZCH AND GELL-MANN IMPLY THAT QUARKS DO EXIST. Haberler, P. L. F. (Institut fuer Hochenergiephysik der Oesterreich, Vienna). Lett. Nuovo Cim.; 4: No. 10, 393-7(8 Jul 1972).

It is suggested that if the light-cone algebra of Fritzsch and Gell-Mann implies that the quark propagator behaves at high energies like a free propagator, then using standard assumptions, the existence of free quarks is implicitly postulated. (L.B.S.)

46605 INCLUSIVE REACTIONS IN THE REGGE POLE MODEL AND EXOTIC RESONANCES. Hara, Yasuo (Tokyo Univ. of Education). Progr. Theor. Phys. (Kyoto); 47: No. 5, 1624-42(May 1972).

The Regge pole model and duality are applied to processes of the type a + b → c + anything. The exotic and nonexotic three-particle channels are defined. The existence of resonances in the $K^+\pi^+\pi^0$, $p\bar{n}\pi^+$, $\bar{K}^0\pi^+p$ and $K^-\pi^-n$ channels is predicted in the model. (auth)

46606 URBARYON REARRANGEMENT AND INCLUSIVE PHENOMENOLOGY. Matsuoka, Takeo (Nagoya Univ., Japan). Progr. Theor. Phys. (Kyoto); 47: No. 5, 1643-62(May 1972).

From the standpoint of urbaryon rearrangement, the characteristic features of various inclusive processes are discussed. In the urbaryon rearrangement scheme, the condition for the early onset of limiting behavior of the inclusive process is predicted, which is different from those given by Chan et al. and Ellis et al. The inclusive processes are classified into six categories according to their distinctive features of the differential cross section. For the process in each category, definite predictions are obtained for the rate in which the differential cross section approaches a limit. It is shown that these predictions are in good agreement with available data. Sum rules among various inclusive processes are also derived. (auth)

46607 POSSIBLE EXPLANATION OF THE STRONG CORE PRESENT IN HADRON REACTIONS. Nakkagawa, Hisao (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 47: No. 5, 1663-75(May 1972).

Concerning the "strong core" in hadron scattering it is investigated, on the basis of the composite model, whether the physical relative wave function can have the inner oscillation when a redundant solution does not exist. The results are 1) even when there is no redundant solution, there exists an inner oscillation, or "strong core" and 2) as inelastic channels begin to open, this "strong core" gradually vanishes. These results strongly suggest the existence of fundamental entities in the hadron. (auth)

46608 SIZE OF HADRONIC CONSTITUENTS AND APPLICABILITY OF SCALING LAW. Matumoto, Ken-iti (Toyama Univ., Japan). Progr. Theor. Phys. (Kyoto); 47: No. 5, 1795-6 (May 1972).

The effect of the size of the urbaryon, which appears together with the effect of the composite structure of hadrons is examined on the basis of transition amplitudes caused by electromagnetic or weak currents. Considering the deep inelastic process e + p → e + anything, lower limits are obtained for the urbaryon and lepton. Information on the validity of the scaling behavior in this region is also obtained. (L.B.S.)

Strong (Baryon No. = 0)

Refer also to abstract: 46458.

46609 (ITF-72-13-P) ON THE DISTRIBUTION OF RESONANCE SPINS IN THE DUAL RESONANCE MODEL. Struminskii, B. V. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 7p. (In Russian). Dep. NTIS (U. S. Sales Only).

The distribution of resonance spins in the dual resonance model is calculated by the statistical mechanics method. (auth)

46610 PARTIAL WAVE RELATIONS FROM FIXED-u DISPERSION RELATIONS. Baacke, J. (Freie Univ., Berlin). Nucl. Phys.; B44: No. 2, 594-604(1972).

Partial wave relations are derived from fixed-u dispersion relations for meson-baryon and meson-meson scattering. General expressions for the integral kernels are given and some problems pertaining to the application of the relations are discussed. (auth)

46611 NONET STRUCTURE OF THE $J^{PC} = 3^{--}$ MESONS. Bramon, A.; Greco, M. (CNEN, Frascati, Italy). Nuovo Cim.; 10A: No. 3, 521-32(1 Aug 1972).

The meson resonances g(1660), $\varphi_N(1650)$, $\varphi_N(1830)$ and $K_N(1760)$ are tentatively grouped in an "ideal" SU_3 nonet having $J^{PC} = 3^{--}$. A discussion of their masses and their decay modes is presented showing general agreement with the available experimental data. The results are also discussed in the light of finite-energy sum rules for the reactions $\pi K \to \omega K$ and $\pi K \to \varphi K$. (auth)

46612 COLLINEAR DISPERSION RELATIONS AND THE $\rho-\pi-\pi$ AND $A_1-\rho-\pi$ COUPLINGS. Nasrallah, N. F. (Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France). Nuovo Cim.; 10A: No. 2, 247-56(21 Jul 1972).

It is shown that the use of collinear dispersion relations and of equal-time commutators obtained from current and field algebra, as well as pole dominance, allows the completion of the program of Riazuddin and Fayyazuddin and Geffen, i.e., the determination of the $\rho-\pi-\pi$ and the two $A_1-\rho-\pi$ coupling constants. It is found that, in this approach, the effect of the A_1 is to reduce considerably (by about 80%) the width of the ρ as given by the KSFR relation, and it is concluded that the assumptions of the previously mentioned authors on the on-mass-shell behavior of the amplitudes are too strong, as has already been suggested by Brown and West, who used on-mass-shell dispersion relations. The results yield the relation $f_A/f_\rho = \sqrt{M_A/M_\rho}$ between the normalizations of the A and ρ fields and, in conjunction with Weinberg's first sum rule a slightly modified version of the KSFR relation. (auth)

46613 LIMITING BEHAVIOR OF PARTIALLY INCLUSIVE REACTIONS. Satz, H. (Univ. of Bielefeld, Ger.). Lett. Nuovo Cim.; 4: No. 9, 357-61(1 Jul 1972).

The limiting behavior of single-particle distributions in partially inclusive interactions is investigated for the case of $p\bar{p} \to \pi$ + pions for $S \to \infty$, where s is the squared total energy. The energy dependence of the cross section is also examined. (L.B.S.)

46614 PROCESS $\nu_\mu + p \to \nu_\mu + p + \pi^0$ IN WEINBERG'S MODEL OF WEAK INTERACTIONS. Lee, B. W. (National Accelerator Lab., Batavia, Ill.). Phys. Lett.; 40B: No. 3, 420-2(10 Jul 1972).

The ratio $R = \sigma(\nu_\mu + p \to \nu_\mu + p + \pi^0)/\sigma(\nu_\mu + n \to \mu + p + \pi^0)$ in Weinberg's model of weak interactions is estimated on the basis of a static model for the neutrino production of the 3,3 resonance. For the Weinberg mixing angle α given by $\sin^2\alpha \leq 0.35$ as deduced from the upper bound on $\sigma(\bar{\nu}_e + e \to \bar{\nu}_e + e)$, it is concluded that $R \gtrsim 0.4$, which is not consistent with the experimental bound $R \lesssim 0.14$. (auth)

46615 PION FORM FACTOR IN THE BETHE–SALPETER MODEL. Fleischer, J. (Univ., Karlsruhe, Ger.); Gutbrod, F. Nuovo Cim.; 10A: No. 2, 235-46(21 Jul 1972).

A Bethe–Salpeter model is presented in which phenomenological potentials are used to reproduce the ρ peak in the $\pi\pi$ scattering amplitude. Then the off-shell amplitude is used to calculate the pion electromagnetic form factor. The Bethe–Salpeter equation is used in the ladder approximation and is solved by iteration and application of the Padé approximation method. Reasonable agreement with the vector-dominance model is achieved. (auth)

Strong (Baryon No. = 1)

Refer also to abstract: 46487.

46616 (BNL-16928) SCALING IN $\pi\pi^- \to pX^-$ AND AN ESTIMATE OF THE TRIPLE-POMERANCHUKON COUPLING. Paige, Frank E.; Wang, Ling-Lie (Brookhaven National Lab., Upton, N. Y.). Jun 1972. 6p. (CONF-720409-3). Dep. NTIS.

From third international conference on experimental meson spectroscopy; Philadelphia, Pa. (28 Apr 1972).

It is shown that the CERN-IHEP data on $p\pi^- \to pX^-$ at 25 and 40 GeV/c exhibit scaling in s'/s. An estimate of the triple-Pomeranchukon coupling is given, and the possibility of its measurement at NAL is discussed. (auth)

46617 (IFVE-STF-71-15) ESTIMATION OF INTERMEDIATE ENERGY CONTRIBUTION TO THE DISPERSION SUM RULES AND ROTATION OF POLARIZATION IN PION–NUCLEON SCATTERING AT HIGH ENERGIES. Aznauryan, I. G.; Solov'ev, L. D. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 21p. (In Russian). Dep. NTIS (U. S. Sales Only).

The Serpukhov data on total cross sections show the violation of the Regge model at energies above 30 GeV. This fact increases the interest in the complete check of this model at lower energies. It is well known that the Regge pole model gives a good descrip-

tion of the cross sections of polarization for pion–nucleon elastic scattering at 4 to 25 GeV. It is shown that this model is also true in describing rotation of polarization in π^-p-scattering at 6 and 16 GeV. (auth)

46618 (IFVE-STF-71-71) TOTAL CROSS-SECTIONS FOR REACTION $\pi^-p \to \pi^0 n$ AT HIGH ENERGIES. Bababev, Z. R. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 8p. (In Russian). Dep. NTIS (U. S. Sales Only).

The total cross section for the reaction $\pi^-p \to \pi^0 n$ at high energies was calculated and compared with experimental data. When calculating use was made of theoretical predictions on differential cross sections at 0° angle for this process with different parametrizations of the difference between the total cross sections for $\pi^\pm$-scattering. (auth)

46619 (JINR-P1-6461) REMARK ON SPECTRUM SYMMETRY OF PION LONGITUDINAL MOMENTA IN π^-p INTERACTIONS AT pc = 4 GeV. Grishin, V. G.; Inogamov, Sh. V.; Yuldashev, B. S.; Yancho, G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1972. 7p. (In Russian). Dep. NTIS (U. S. Sales Only).

It is shown that the spectrum symmetry of the pion longitudinal momenta in π^-p interactions at pc = 4 GeV is observed in the system where $R = 1.69 \pm 0.15$. Possible interpretation of this effect is presented. (auth)

46620 (JINR-P4-6475) QUASI-THRESHOLD BEHAVIOR OF THE $\pi + N \to N + (\gamma\text{-VIRTUAL})$ PROCESS AMPLITUDE. Surovtsev, Yu. S.; Tkebuchava, F. G. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1972. 8p. (In Russian). Dep. NTIS (U. S. Sales Only).

It is shown that the cross section of the process $\pi + N \to N + (\gamma\text{-virtual})$ at small values of the virtual photon momentum is determined, in general, by the Born terms of the amplitude. Thereby, the description of the process becomes nearly slowly independent when the virtual photon "mass" tends to its maximum value at fixed total energy. (auth)

46621 TESTS OF THE SPIN ASSIGNMENT AND EQUAL-PHASE ASSUMPTION FOR HIGH-SPIN BARYONS. Donohue, J. T. (Univ., Nice). Nucl. Phys.; B44: No. 2, 355-64(1972).

For baryon resonances with $\frac{9}{2} \le J \le \frac{19}{2}$ a set of tests are proposed for the spin assignment. The tests are relations between the sums of squares of the even-L statistical-tensors t_L^M and the target polarization for the reaction $M + B(P) \to M + B^*$, and are extensions of an earlier result. In addition it is shown how these relations can be used, when J is known, to test the dynamical assumption that all helicity amplitudes for the reaction have the same phase, this without a polarized target and without observing a parity-violating decay. (auth)

46622 PHENOMENOLOGICAL PRESCRIPTION FOR REGGE CUTS. Ringland, G. A. (Rutherford High Energy Lab., Chilton, Eng.); Roberts, R. G.; Roy, D. P.; Tran Thanh Van, J. Nucl. Phys.; B44: No. 2, 395-412(1972).

The failure of the old Reggeized absorption model is attributed to the wrong relative phase of pole and cut. A model for vector and tensor exchange is proposed in which the old absorption model is used to generate the cut coming from the component of the pole term with phase $e^{-i\pi\alpha(t)}$ [planar duality diagram]. However, the absorption model cut obtained from the constant phase part of the pole term [non-planar duality diagram] is rotated in phase by $\frac{1}{2}\pi$. This model may be applied over a wide range of energy, but not, by crossing symmetry, at infinitely high energies. This prescription is used to discuss $0^- + \frac{1}{2}^+ \to 0^- + \frac{1}{2}^+$ reactions using a dual pole input with wrong signature nonsense zeros and SU(3) constraints. The $\pi^-p \to \pi^0 n$ polarization and also the cross section inequalities and polarizations of hypercharge exchange reactions are obtained. Further, this model gives a quantitatively better understanding of the crossover zeros. An additional bonus is that from a nonsense choosing P′ input a P′ amplitude is obtained qualitatively similar to that found by FESR and the no-compensation form required by pure pole fits. Predictions of polarization in $\bar{K}N$ and KN charge exchange and $\pi N \to \eta N$ are given. (auth)

46623 NATURE OF ABSORPTION. Barger, V. (CERN, Geneva); Geer, K.; Halzen, F. Contract AT(11-1)-881. Nucl. Phys.; B44: No. 2, 475-89(1972).

The imaginary helicity non-flip ω exchange amplitudes in KN and NN scattering are determined versus t and s from data on elastic differential cross section differences. The ω-universality prediction, $\text{Im}\,\omega_N(t) = 3\,\text{Im}\,\omega_K(t)$, is found to be satisfied for $0 \le |t| \le 0.5$, indicating that the absorptive cuts at small t preserve universality. The impact parameter distributions of the ω amplitudes show: (i) a peripheral peak centered around $b \approx 1$ fm, with $\Delta b \approx \pm 0.5$ fm in KN and $\Delta b \approx \pm 0.75$ fm in NN; (ii) a sizeable negative contribution at small b, more negative in NN than in KN, (iii) a smaller tail of negative contributions around $b \approx 2$ fm. Strong absorption of the ω-pole imaginary amplitude with λ values around two is needed to reproduce this structure. A new version of the absorption model, suggested by πN amplitude analysis, is confirmed by our results. (auth)

46624 ANALYSIS OF KAON–NUCLEON SCATTERING AMPLITUDES IN THE INTERMEDIATE ENERGY REGION. Fukugita, M.; Inami, T. (Tokyo Univ.). Nucl. Phys.; B44: No. 2, 490-508 (1972).

"Two component theory" of duality was tested with new $\bar{K}N$ and KN partial wave data in the intermediate energy region. A comprehensive study of the s-channel helicity amplitudes constructed separately from the background and resonant parts of partial wave amplitudes is presented. It is found that the background and resonant amplitudes have properties which are represented well by the pomeron and ordinary Regge exchanges, respectively. This approach also sheds new light on previous FESR calculations and the problem of exchange degeneracy. (auth)

46625 AMPLITUDE ANALYSIS OF πN COULOMB INTERFERENCE DATA. Krubasik, E. (Univ., Karlsruhe, Ger.). Nucl. Phys.; B44: No. 2, 558-72(1972).

πN scattering amplitudes near the forward direction were derived directly from the data in the 7 to 20 GeV/c region. A linear exponential behavior for the $I_t = 0$ part of the nonflip amplitude is found. The slopes of the diffraction peak yield a shrinkage in this energy range. Results for the real parts of the $I_t = 0$ and $I_t = 1$ components are compatible with the dispersion relation, but difficulties are encountered in a conclusive test of these relations. An energy independent crossover is found at $0.1 \le -t \le 0.15$ $(\text{GeV/c})^2$ and its mechanism is explained. A non-Regge-pole contribution is seen in the $I_t = 1$ component of the nonflip amplitude. (auth)

46626 MASS RADIUS OF THE NUCLEON. Hare, M. G.; Papini, G. (Univ. of Saskatchewan, Regina). Can. J. Phys.; 50: No. 11, 1163-8(1 Jun 1972).

The mean radius of the mass distribution of the nucleon is determined to be $\langle r_1 \rangle = 0.7$ fm. The calculation makes use of sidewise, unsubtracted, threshold dominated dispersion relations for the form factors appearing in the matrix elements of the contracted energy-momentum tensor. It uses a π meson-nucleon intermediate state expansion. (auth) (Canada)

46627 DUALITY AND BACKWARD PEAKS. Halzen, F. (CERN, Geneva). pp 65-96 of High Energy Phenomenology. /Tran Thanh Van, J. (ed.). Paris; Laboratoire de Physique Theorique et Hautes Energies (1971).

From Conference of Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971). See CONF-710345-(Vol.2).

The implications of duality constraints on baryon exchange are studied using a factorizable Regge pole model for pseudoscalar meson baryon → pseudoscalar meson baryon scattering, and the patterns of baryon exchange degeneracy are derived. The experimental and phenomenological tests of the scheme are discussed: duality sum rule, effective residues, and Regge fits. Absence of parity doublets and the behavior of backward peaks at large momentum transfers are then examined. (France)

46628 BARYON SPIN DETERMINATIONS USING POLARIZED TARGETS. Donohue, J. T. (Univ., Nice). pp 181-5 of High Energy Phenomenology. /Tran Thanh Van, J. (ed.). Paris; Laboratoire de Physique Theorique et Hautes Energies (1971).

From Conference of Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971). See CONF-710345-(Vol. 2).

A new method for determining the spin (J) of the baryon resonances produced in quasi-two body reactions with polarized targets is discussed. Decays are analyzed in the framework of the spin-density matrix, using the concept of pure-state and the theorem of Eberhard and Good. The $a_{LM}(t,\phi)$ coefficients of the spherical harmonics expansion for even-L are measured for two or more values of the polarization (P); t_{LM} or ρ_E is then determined by assuming a definite value of J; $(d\sigma/d\Omega)^{\frac{1}{2}}\,(\text{Tr}(\rho_E^2)^{-\frac{1}{4}})$ is plotted as a function of $1-p^2$) and an attempt is made to discover whether it lies on a straight line passing through the origin. (France)

46629 LINE REVERSED REACTIONS. Michael, C. (CERN, Geneva). pp 247-57 of High Energy Phenomenology.

/Tran Thanh Van, J. (ed.). Paris; Laboratoire de Physique Theorique et Hautes Energies (1971).

From Conference of Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971). See CONF-710345-(Vol.2).

Recent data on line reversed reactions are presented. Comparisons between $K^+n \to K^0p$ and $K^-p \to \bar{K}^0n$ at 2.3 and 3 GeV/c; $\pi^+p \to p\pi^+$ and $\bar{p}p \to \pi^-\pi^+$, $\pi^-p \to p\pi^-$ and $\bar{p}p \to \pi^+\pi^-$, and $K^+p \to pK^+$ and $\bar{p}p \to K^-K^+$ at 5 GeV/c; $\bar{K}N \to \pi\Sigma$ and $\pi N \to K\Sigma$, and $\bar{K}N \to \pi\Lambda$ and $\pi N \to K\Lambda$ indicate the presence of low lying singularities explaining the energy dependence of the cross section variations in the 3 to 8 GeV/c region. The complexity of the angular momentum plane description for the scattering amplitude is thus emphasized. (France)

46630 PHENOMENOLOGICAL ANALYSIS OF πN AND KN CHARGE-EXCHANGE REACTIONS. Dronkers, J. (CEN de Saclay, Gif-sur-Yvette, France). pp 259-66 of High Energy Phenomenology. /Tran Thanh Van, J. (ed.). Paris; Laboratoire de Physique Theorique et Hautes Energies (1971). (In French).

From Conference of Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971). See CONF-710345-(Vol.2).

$\pi^-p \to \pi^0n$, $\pi^-p \to \eta n$, $K^-p \to \bar{K}^0n$ and $K^+n \to K^0p$ reactions with $1^-(\rho)$ and $2^+(A_2)$ octet exchange in the crossed channel were studied. The t = 0 differential cross sections were extrapolated (independent of energy) from the most forward experimental points. Extrapolation errors are more important than experimental errors. PP, PC, and DP models were used, and an attempt was made to determine which parameters could be found by fitting. (France)

46631 COMPLEX CONJUGATE REGGE POLES. Roy, D. P. (Rutherford High Energy Lab., Chilton, Eng.). pp 309-23 of High Energy Phenomenology. /Tran Thanh Van, J. (ed.). Paris; Laboratoire de Physique Theorique et Hautes Energies (1971).

From Conference of Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971). See CONF-710345-(Vol.2).

The mechanism of pole-cut collision is studied using multiperipheral unitarity. The general features of the resulting complex-conjugate poles are examined, the phenomenological implications of these complex conjugate poles being envisaged. Being on the unphysical sheet, these poles are demonstrated not to act directly on the scattering cross section but to control it indirectly through a bump of the Breit-Wigner type in the cut discontinuity. (France)

46632 K^+p PHASE SHIFT ANALYSIS AND EXOTIC RESONANCES. Yokosawa, A. (Argonne National Lab., Ill.). pp 325-36 of High Energy Phenomenology. /Tran Thanh Van, J. (ed.). Paris; Laboratoire de Physique Theorique et Hautes Energies (1971).

From Conference of Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971). See CONF-710345-(Vol.2).

New data concerning K^+p differential elastic cross sections and polarization (some at backward angles) were analyzed. The total number of data points is approximately twice that used in previous analysis, the incident momentum being in the 0.52 to 1.89 GeV/c range. A solution was obtained between 0.52 and 1.21 GeV/c and two other solutions were obtained between 1.37 and 1.89 GeV/c. Partial wave amplitudes are given for each of them. A resonant-like behavior in the P_3 partial wave was observed for each solution. (France)

46633 PHENOMENOLOGY OF TOTAL CROSS SECTIONS AND FORWARD SCATTERING AT HIGH ENERGY. Barger, V. (Univ. of Wisconsin, Madison). pp 337-55 of High Energy Phenomenology. /Tran Thanh Van, J. (ed.). Paris; Laboratoire de Physique Theorique et Hautes Energies (1971).

From Conference of Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971). See CONF-710345-(Vol.2).

Recent σ_t experiments at Serpukhov indicate that, above 30 GeV, modifications in the Regge pole picture are necessary. The deviations of the Serpukhov $\sigma_t(\pi N)$ and $\sigma_t(KN)$ data from the Regge pole expectations can be ascribed to several radically different forms of asymptotic growth with energy: Pomeranchuk theorem violation, complex Regge poles, infinitely rising σ_t, vanishing asymptotic σ_t. The asymptotic forms selected by ρ and ω exchanges are tested using $K_L \to K_S$ regeneration, charge exchange scattering and the real part/imaginary part ratio for the elastic forward scattering amplitudes. (France)

46634 SOME IMPLICATIONS OF A VIOLATION OF THE POMERANCHUK THEOREM. Finkelstein, J. (CERN, Geneva). pp 357-72 of High Energy Phenomenology. /Tran Thanh Van, J. (ed.). Paris; Laboratoire de Physique Theorique et Hautes Energies (1971).

From Conference of Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971). See CONF-710345-(Vol.2).

Theoretical consequences of the assumption of a violation of the Pomeranchuk theorem are discussed for nonforward scattering. K^+p and K^-p total cross sections are examined, and data on K_L^0 regeneration are shown not to favor the assumption of an asymptotic inequality for particle and antiparticle total cross sections at high energy. (France)

46635 EXPERIMENTAL LOW-ENERGY BEHAVIOR OF DIPS AND VENEZIANO DUALITY. Odorico, R. (CERN, Geneva). pp 397-424 of High Energy Phenomenology. /Tran Thanh Van, J. (ed.). Paris; Laboratoire de Physique Theorique et Hautes Energies (1971).

From Conference of Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971). See CONF-710345-(Vol.2).

The phenomenological convenience in considering dip behavior at low energy is illustrated. The K^-p scattering, πp scattering, and Λ-production processes are examined. Simple empirical relations between dips and resonances are demonstrated. Low-energy dip behavior is apparently simple only when resonances are regularly arranged according to a unique Regge sequence with a constant spacing in mass squared. (France)

46636 REVIEW OF NEAR-FORWARD πN SCATTERING AMPLITUDES AT HIGH ENERGIES. Hoehler, G. (Univ., Karlsruhe, Ger.). pp 457-84 of High Energy Phenomenology. /Tran Thanh Van, J. (ed.). Paris; Laboratoire de Physique Theorique et Hautes Energies (1971).

From Conference of Moriond meeting on the phenomenology of weak and electromagnetic interactions; Meribel-les-Allues, France (7 Mar 1971). See CONF-710345-(Vol. 2).

An analysis of πN scattering experimental data at high energies and small momentum transfer is presented. Fixed-t dispersion relations and charge-independence are used for interpolating and determining the forward amplitudes $C^{\pm}(\nu,0)$ (imaginary and real parts) and their derivatives. High energy models and phase shift sets are tested. The $A^+ \to 0$ condition is preferred to helicity conservation, provided that it is compatible with the data, since it involves a smaller number of adjustable functions. (France)

46637 s-CHANNEL HELICITY AMPLITUDES WITHOUT POMERON FOR ELASTIC K^+-p AND π^-p CHARGE EXCHANGE SCATTERING. Karasuno, T.; Minami, S. (Osaka City Univ.). Lett. Nuovo Cim.; 4: No. 13, 647-50(29 Jul 1972).

Two models are examined for the helicity-nonflip and helicity-flip amplitudes without pomeron for π^-p charge-exchange scattering. In the first model, only the imaginary part of the (nonpomeron) Regge amplitude is peripheral; in the second, both the imaginary and real parts on the (nonpomeron) Regge amplitudes without helicity-flip are peripheral. Using phase shift solutions, it is shown that the first model is more promising than the second. (L.B.S.)

46638 $A_1\rho\pi$ COUPLINGS AND t-CHANNEL HELICITY CONSERVATION. Roy, T.; Roychowdhury, A.; Banerjee, S. N. (Jadavpur Univ., Calcutta). Lett. Nuovo Cim.; 4: No. 13, 598-600(29 Jul 1972).

It is shown from an analysis of the $\pi N \to A_1N$ interaction that the helicity conservation in the t-channel is in no way connected with the S- and D-wave contributions to the $A_1\rho\pi$ coupling constant. (L.B.S.)

46639 POMERON AND f EXCHANGE AMPLITUDES IN ELASTIC π^+-p SCATTERING. Davier, M. (Stanford Univ., Calif.). Phys. Lett.; 40B: No. 3, 369-72(10 Jul 1972).

The dual absorptive model of Harari is shown to explain consistently the s and t dependence of the sum of π^+p and π^-p elastic differential cross sections at high energy. The Pomeron amplitude shrinks at a rate similar to that of K^+p elastic scattering while the f amplitude is shown to be dominated by peripheral partial waves at a radius ~1 fm. Finally, the shrinkage and s dependence of the f amplitude follow a canonical Regge behavior. (auth)

46640 REMOVAL OF AMBIGUITIES FROM INELASTIC PHASE-SHIFT ANALYSIS. Burkhardt, H. (Univ. of Birmingham, Eng.). Nuovo Cim.; 10A: No. 2, 379-88(21 Jul 1972).

It is shown that the ambiguities in principle of phaseshift analysis are removed if, in addition to the differential cross section, the discontinuity of the amplitude across the nearby cut in $\cos\theta$ is given; unitarity is only used to resolve a twofold discrete ambiguity. The extension to pion-nucleon scattering shows that differential cross section and polarization measurements, together

with the discontinuity, are sufficient to leave only a fourfold ambiguity for unitarity, or an R measurement, to resolve. Questions of numerical analysis are not discussed. (auth)

46641 LOW-ENERGY THEOREM FOR PION–NUCLEON SCATTERING FROM PION SOURCE DYNAMICS. Pradhan, T.; Khare, A. V. (Saha Inst. of Nuclear Physics, Calcutta). Lett. Nuovo Cim.; 4: No. 9, 369-72(1 Jul 1972).

A low-energy theorem is derived for the spin nonflip, isospin-flip πN scattering amplitude in terms of the πN coupling constant. The derivation of the theorem follows from the algebra of pion sources in which the pion sources and the isospin generators form a SU(2) × SU(2) algebra. It is suggested that the low-energy theorem may be used as a definition of πN coupling constant just as the Thirring theorem in quantum electrodynamics is used to define renormalized charge. (L.B.S.)

46642 DUALITY-BREAKING EFFECTS IN A MODEL FOR MESON–BARYON SCATTERING. Gage, D. W.; O'Donovan, P. J. (Arizona State Univ., Tempe). Nuovo Cim.; 10A: No. 3, 560-72 (1 Aug 1972).

Duality-violating effects are examined in the context of an exchange-degenerate multiple-scattering model incorporating strong EXD for poles, SU_3 at the vertices and s-u crossing. Ten parameters, including d/f ratios, are used to simultaneously fit cross sections for $K^-p \to \pi^-\Sigma^+$, $\pi^+p \to K^+\Sigma^+$, $K^-p \to \bar{K}^0n$, $K^+n \to K^0p$, $\pi^-p \to \pi^0n$, and $\pi^-p \to \eta n$. The qualitatively different energy dependences of the HCEX and CEX line-reversed cross section differences arise naturally from the fact that the model requires equal absorption in CEX line-reversed reactions and unequal absorption in the HCEX reactions. The cross section fits are excellent for the HCEX and reasonable for the CEX reactions; polarizations are correct in sign. The d/f ratios obtained are close to the quark-model SU_6 values. The model is compared with other multireaction fits and their differences and relative successes are discussed. (auth)

46643 PHOTON EXCHANGE IN $\pi + N \to \rho + N$ REACTIONS. Zima, V. G. (Donetsk Physical-Technical Inst., USSR). Ukr. Fiz. Zh. (Russ. Ed.); 16: No. 9, 1518-23(Sep 1971). (In Russian).

It is shown that interference of photon exchange in the t-channel of the reaction $\pi^\pm + N \to \rho + N$ with nucleon exchange in the s- and u-channel is a remarkable quantity. It is necessary to take into consideration nucleon exchange at the same time with one-pion exchange if ρ-meson is coupled to a conserved source. In the reactions $\pi^\pm + p \to \rho^\pm + p$ photon exchange has independent importance for $|t| < 0.01$ GeV^2. (auth)

46644 MANY-NEUTRON RESONANCES. Karmanov, V. A.; Kondratyuk, L. A.; Shapiro, I. S. (Inst. of Theoretical and Experimental Physics, Moscow). pp 496-511 of Problems of Modern Nuclear Physics. /Kolybasov, V. M. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

From second symposium on the problems of nuclear physics; Novosibirsk, USSR (12 Jun 1970).

Certain aspects of the theory of nuclear resonances are examined, for example, the lightest Δ-nuclei which contain the isobar $\Delta(1236)$. The scattering amplitude of an unstable particle by a stable N may be determined using the properties of the three-particle amplitude $\pi NN \to \pi NN$. Models for an induced nonexchange interaction ΔN and an exchange interaction ΔN are discussed. An enumeration of states participating in the isotriplet and the isoquintet is made for two-baryon Δ-nuclei and three baryon nuclei. (K.S.W.)

46645 VIOLATION OF POMERANCHUK THEOREM AND RELATIONS BETWEEN THE DIFFERENTIAL CROSS SECTIONS. Rekalo, M. P. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 16: No. 9, 1450-5(Sep 1971). (In Russian).

Consequences of the Pomeranchuk theorem violation are analyzed, assuming that the amplitudes of elastic hadron scattering at a zero degree become real values at asymptotic high energies. It is shown that the differential cross sections of the charge-exchange processes $\pi^- + p \to \pi^0 + n$, $K^+ + n \to K^0 + p$ and of the elastic processes (πN)- and (KN)-scattering must be of one order in this energy region; while the differential cross sections of the processes $\pi^-p \to \eta + n$, $\pi^- + p \to X + n$ must be essentially less. Consequences of the quark model for the processes $\gamma + N \to N + V^0$ must remain valid even if the Pomeranchuk theorem is not valid. (auth)

46646 HELICITY CONSERVATION IN $\pi N \to A_1N$ SCATTERING. Biyajima, Minoru (Tokyo Univ. of Education). Progr. Theor. Phys. (Kyoto); 47: No. 5, 1601-9(May 1972).

The s- and t-channel helicity conservation hypotheses in $\pi N \to A_1N$ reaction are studied. It is shown that the main properties of density matrices for this reaction can be explained well by using the t-channel helicity conservation hypothesis and the hypothesis of the Pomeron dominance. Requiring the factorization theorem for s-channel helicity conservation in the nucleon vertex, the following scattering amplitude is obtained: $T_{\pi N \to A_1 N} = (e \cdot q_\pi) K_\mu \bar{u} \gamma_\mu u$. However, this amplitude does not mean the s-channel helicity conservation. (auth)

46647 URBARYON REARRANGEMENT AND INELASTIC TWO-BODY PROCESSES. Kobayashi, Akizo (Nagoya Univ., Japan). Progr. Theor. Phys. (Kyoto); 47: No. 5, 1779-81(May 1972).

The nonvanishing polarization and the breaking of line reversal relation in the differential cross sections for inelastic meson–baryon two-body processes are investigated on the basis of urbaryon rearrangement diagrams. Qualitative results for elastic, charge-exchange, strangeness-exchange, and double charge-exchange interactions are found to reproduce rather well the experimental data. (L.B.S.)

46648 COMMENT ON THE BACKWARD $K^-n \to \Lambda\pi^-$ SCATTERING. Seth, V. P. (International Centre for Theoretical Physics, Trieste, Italy). Progr. Theor. Phys. (Kyoto); 47: No. 5, 1774-6 (May 1972).

The contributions from N_α and N_γ trajectories for the backward scattering process $K^- + n \to \Lambda + \pi^-$ are taken with the trajectories' parameters obtained from the Chew–Frautschi plot to analyze the differential cross section and polarization with residue functions as the unknown constant parameters. The residue parameters thus obtained from the best fit are used to predict the values of some coupling constants. (L.B.S.)

Strong (Baryon No. ≥ 2)

Refer also to abstracts: 46457, 46787, and 47100.

46649 (JINR–P2-6395) ANALYSIS OF INELASTIC COLLISIONS OF PARTICLES WITH NUCLEI AT VERY HIGH ENERGIES. Barashenkov, V. S.; Eliseev, S. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 15p. (In Russian). Dep. NTIS (U. S. Sales Only).

Experimental data on pion- and nucleon–nucleus interactions at the energies much more than 10 GeV are analyzed on the basis of the cascade-evaporation model taking into account the decrease of density of number of intranuclear nucleons in the process of the cascade development. The experiment and theory can be coordinated right up to T ≈ 100 GeV within the measurement errors. At large energies the cascade multiplicity of shower particles noticeably exceeds the experimental values. The influence of the many-particle interaction effect is discussed. (auth)

46650 (KFK–1547) SIMPLE THEORY OF PROTON–PROTON FINAL STATE INTERACTION IN THE REACTION d + p → p + p + n. Matthaey, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik); Zeh, H. D. (Heidelberg Univ. (West Germany). Institut fuer Theoretische Physik). Mar 1972. 20p. Dep. NTIS (U. S. Sales Only).

The amplitude for deuteron break-up in deuteron-proton-collision including Coulomb final state interaction (in all partial waves) is derived analytically. The calculation is based on the assumption of a two-step reaction with break-up mechanism of zero range. Nuclear final state interaction is taken into account under the same approximations in s-waves. Comparison with experiments indicates a clear improvement compared to the Watson-Migdal theory. (auth)

46651 (RPP/T–18) AN ESTIMATE OF REGGE CUTS FROM INCLUSIVE FINITE MASS SUM RULES. Roy, D. P.; Roberts, R. G. (Rutherford High Energy Lab., Chilton (England)). 1972. 16p. Dep. NTIS (U. S. Sales Only).

Inclusive data on $K^+ \xrightarrow{\rho} K^0$ and $K^- \xrightarrow{\rho} \bar{K}^0$ are used to calculate the $\rho\rho$ and A_2A_2 Regge cuts in forward nucleon–nucleon scattering. Although the energies for which data exist are too low to allow a precise estimate, an upper bound for the cut magnitude can be obtained which is at the level given by the eikonal model. (auth)

46652 TWO-PION EXCHANGE ΛN POTENTIAL. Riska, D. O. (State Univ. of New York, Stony Brook). Phys. Lett.; 40B: No. 2, 177-80(26 Jun 1972).

The two-pion exchange contribution to the ΛN potential is calculated from the field theoretic scattering amplitude. The effect of the Adler consistency condition for the $\pi\Lambda$ and πN amplitudes is taken into account, as well as the s-wave $\pi\pi$ interaction. (auth)

46653 RECOIL EFFECT IN QUASI-ELASTIC HADRON–DEUTERON SCATTERING. Alberi, G. (Univ., Trieste, Italy. Istituto Nazionale di Fisica Nucleare, Trieste, Italy); Gregorio, M. A.; Seth, V. P. Nucl. Phys.; B44: No. 2, 437-44(1972).

The problem of hadron-deuteron quasi-elastic scattering is considered for large momentum transfers. The longitudinal part of the momentum transfer is included in the single and double scattering. It is shown that a simple enhancement factor relates the double scattering contribution to the differential cross section to the same quantity in Glauber theory. (auth)

46654 STRONG-INTERACTION FORM FACTOR OF PROTON IN HIGH-ENERGY PROTON–PROTON ELASTIC SCATTERING. Kato, S. (Hiroshima Univ.). Nuovo Cim.; 10A: No. 1, 48-52(1 Jul 1972).

An analysis of high-energy proton–proton elastic-scattering data is made in terms of one-particle exchange type amplitude. The results show that the proton form factor is constant at large momentum transfer. This may be interpreted as evidence for the existence of a pointlike core in the proton. (auth)

46655 SPIN STRUCTURE OF pd SCATTERING IN GLAUBER THEORY. Alberi, G. (Univ., Trieste, Italy. Istituto Nazionale di Fisica Nucleare, Trieste, Italy); Bertocchi, L.; Gregorio, M. A. Nuovo Cim.; 10A: No. 1, 37-47(1 Jul 1972).

The differential cross section, polarization and asymmetry, measured in recent proton–deuteron elastic scattering experiments, were computed using the Glauber multiple-scattering theory. The nucleon–nucleon amplitudes are obtained from recent phase-shift analyses; results from different sets of phase shifts are compared. (auth)

46656 FURTHER RESULTS FROM MULTI-REGGE MODELS APPLIED TO THE $pp \rightarrow pp\pi^-\pi^+$ REACTION AT 13.1 GeV/c. Le Guyader, J. (Institut de Physique Nucleaire, Paris); Sene, M.; Ginestet, J.; (and others). Nuovo Cim.; 10A: No. 3, 573-95(1 Aug 1972).

The $pp \rightarrow pp\pi^+\pi^-$ reaction at 13.1 GeV/c is analyzed in terms of the two multi-Regge models proposed by Chan et al., and by Berger et al. In the first model (CLA model) the introduction of the Δ trajectory exchange is discussed and a comparison is made with the experimental results. In the second model, which is a Regeized pion-exchange model, the π trajectory has a hyperbolic form. The theoretical curves give a satisfactory representation of most of the distributions such as longitudinal momenta or effective-mass spectra. However, some discrepancies remain and are discussed. A comparison is made with the results previously obtained at 8 GeV/c. (auth)

46657 INCLUSIVE REACTIONS AND THE ASYMPTOTIC BEHAVIOR OF PROTON–PROTON COLLISIONS. Minakata, H. (Hiroshima Univ.). Lett. Nuovo Cim.; 4: No. 13, 593-7 (29 Jul 1972).

The asymptotic behavior of p-p inclusive interactions is studied, where the inclusive cross section is regarded as the totality of the inelastic processes. The inelastic cross section is written in terms of the one-particle distribution function (OPDF) and a dipole and a monopole fit to the OPDF are examined. (L.B.S.)

46658 EXPERIMENTAL SITUATION IN THE INVESTIGATION OF MANY-NUCLEON RESONANCES. Leksin, G. A. (Inst. of Theoretical and Experimental Physics, Moscow). pp 511-31 of Problems of Modern Nuclear Physics. /Kolybasov, V. M. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

From second symposium on the problems of nuclear physics; Novosibirsk, USSR (12 Jun 1970).

A possible contradiction between the concepts of isonuclei and many-baryon resonances is explored. Well-known methods used in the study of boson and baryon resonances and in the analysis of di-baryon systems have led to the investigation of: energy dependence of total scattering cross sections; energy dependence of the differential cross section of a canal; the number of reaction occurrences as a function of the invariant mass of the system; and the number of reaction occurrences as a function of the "deficient mass," which is essentially the invariant mass of the system. Each of these problems is discussed. (K.S.W.)

46659 REGGE PHENOMENOLOGY OF INCLUSIVE SPECTRA IN THE CENTRAL REGION. Chan, Hong-mo (Rutherford High Energy Lab., Chilton, Eng.); Miettinen, H. I.; Roy, D. P.; Hoyer, P. Phys. Lett.; 40B: No. 3, 406-10(10 Jul 1972).

In the light of new data from the ISR, initial steps are taken towards the Regge analysis of inclusive spectra in the central region. It is shown that some features in the data necessitate the introduction of a further singularity in addition to the Pomeron and the meson trajectories ρ–f–ω–A_2. The resulting model yields many predictions via duality and factorisation which can easily be tested at ISR and Batavia energies. (auth)

46660 SIMPLE DESCRIPTION OF HIGH ENERGY ELASTIC SCATTERING. Kane, G. L. (Rutherford High Energy Lab., Chilton, Eng.). Phys. Lett.; 40B: No. 3, 363-8(10 Jul 1972).

Motivated by ideas about the structure of high energy amplitudes in impact parameter space, a simple form (equation six) is suggested for the dominant elastic amplitude (Pomeron exchange in Regge language). It is imaginary at $t = 0$ but has a significant real part away from $t = 0$ even at very high energies. It is able to describe the experimental features of all elastic scattering to the highest ISR energies, including the increase in slope for $-t < 0.15$ and considerable shrinkage in pp scattering for $-t < 0.15$ with little shrinkage for $0.2 < -t < 0.3$; the small angle slope increase means that even elastic hadron interactions have an important peripheral contribution. The elastic amplitude has the phase variation with t needed in recent work to understand the πN scattering amplitude at 6 GeV/c in terms of the absorption model; this phase variation cannot be simply parametrized by a Regge pole. Using this Pomeron also solves the long-standing shrinkage problem for the absorption model. (auth)

46661 TRIPLE REGGE COUPLINGS AND THE CENTRAL REGION OF INCLUSIVE DISTRIBUTIONS. Humble, S. (Daresbury Nuclear Physics Lab., Warrington, Eng.). Phys. Lett.; 40B: No. 3, 373-7(10 Jul 1972).

A model for inclusive distributions near $x = 0$ is derived in terms of a product of triple Regge couplings. The model predicts a cusp structure in the high energy distributions, and explains the slow approach to a scaling limit for the exotic $\bar{p}$ and k^- production from pp collisions in terms of their masses. (auth)

46662 REMARKS ON AVERAGE PION MULTIPLICITIES AT HIGH ENERGIES. Charlton, G. R.; Thomas, G. H. (Argonne National Lab., Ill.). Phys. Lett.; 40B: No. 3, 378-80(10 Jul 1972).

The ISR data on $pp \rightarrow \gamma$ imply a π^0 transverse momentum spectrum which is consistent with the average of the π^+ and π^- spectra, at the same energy, both in shape and in normalization. Therefore, the average numbers of produced pions per inelastic pp collision at the ISR can be compared with data at lower energies, and with cosmic ray results. (auth)

46663 REGGEON CONTRIBUTIONS IN A TWO-FIRE-BALL MODEL. Margolis, B.; Meggs, W. J. (McGill Univ., Montreal). Lett. Nuovo Cim.; 4: No. 10, 413-16(8 Jul 1972).

The role of low-lying trajectories in inelastic pp interactions is investigated within the framework of two-fireball model. It is found that the proton spectrum will be dominated by protons from the decay of fireballs that are produced by pomeron exchange whereas the pion spectrum will be dominated at very high energies by pions from the decay of less probable but more massive fireballs produced by Regge exchange. (L.B.S.)

46664 INTRANUCLEAR CASCADES IN LIGHT NUCLEI. Abdinov, O. B.; Barashenkov, V. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Pol.; B3: No. 3, 385-90(1972). (In Russian).

The model of intranuclear cascades taking into account the changes in the density of a target-nucleus as the cascade develops, is employed for light nuclei of carbon type. In the energy range $T \leq 1$ GeV, the density affects slightly the properties of cascade particles (the number of low-energy particles being somewhat decreased) but it influences very strongly the yield of various isotopes already at the energies T = 300 to 400 MeV. The isotope yield also depends on the cluster structure of a target-nucleus. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstracts: 46508 and 46714.

46665 (CTH-ITP-71-14) INTERNAL QUANTUM NUMBERS AND HOMOGENEOUS SPACES. Sears, Richard (Chalmers Tekniska Hogskola, Goteborg (Sweden). Institutionen for Teoretisk Fysik). 18 May 1971. 39p. Dep. NTIS (U. S. Sales Only).

A study of the possibility of finding explicit representations of the Poincaré group, which are labelled by additional discrete quantum numbers, was initiated. The main objective was to examine the extent to which a formalism developed by Kihlberg may be generalized to the case of a larger spectrum-generated group. An unsatisfactory aspect was the fact that it was impos-

sible to maintain the isospin invariance of the interactions. (Sweden)

46666 (IC-72/49) CONJUGACY AND STABILITY THEOREMS IN CONNECTION WITH CONTRACTION OF LIE ALGEBRAS. Shah, K. Tahir (International Centre for Theoretical Physics, Trieste (Italy)). Jun 1972. 20p. Dep. NTIS (U. S. Sales Only).

Let $a \in \Gamma_n(\bar{g})$, the n-dimensional Grassmannian variety, and $\bar{g}$ be a Lie algebra of the dimension $m \geq n$. Some properties of the set $B < \overline{G(a)} - G(a)$ where $\overline{G(a)}$ is the Zariski closure of the orbit of $G = GL(\bar{g})$ at the point a are studied. The group $GL(\bar{g})$ is the group of automorphisms of $\bar{g}$. The set B is shown to be the set of Lie algebras which are contractions of $\bar{a}$. $\bar{a}$ is a subalgebra of $\bar{g}$. The main results are the theorems on the conjugacy of contracted algebras and the stability of Lie algebra $\bar{a}$ under contraction. The conjugacy theorem relates the algebras in the set B. (auth)

46667 (ITF-71-117-P) RELATIVISTIC TRANSFORMATIONS OF THE ONE-PARTICLE WAVE FUNCTIONS. Faustov, R. N. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 14p. (In Russian). Dep. NTIS (U. S. Sales Only).

The properties of the wave functions of free particles with arbitrary spins with respect to the transformations of the Poincaré group are considered. (auth)

46668 EIGENVALUES OF THE INVARIANT OPERATORS OF THE UNITARY UNIMODULAR GROUP SU(n). Partensky, A. (Univ. Claude Bernard, Lyon). J. Math. Phys. (N. Y.); 13: No. 5, 621-5(May 1972).

By a purely infinitesimal method the eigenvalues of the Biedenharn's invariant operators from I_2 to I_6 for the SU(n) group are derived. It is shown that the general formula, quoted from Racah's work by Baird and Biedenharn, to obtain the eigenvalues of the invariant operators, is valid only for the two first I_2 and I_3 operators and not for the higher order invariants. The correct values are given for the first invariant till I_6. (auth)

46669 STRUCTURE OF RELATIVITY GROUPS. Lugiato, Luigi A. (Univ., Milan); Gorini, Vittorio. J. Math. Phys. (N. Y.); 13: No. 5, 665-71(May 1972).

An attempt is made to define the class of equivalent reference frames in special relativity in terms of a purely kinematical characterization of the notion of free material point and using homogeneity of space and time, isotropy of space, and unidirectional time flow. The problem of finding the possible forms of the relativity group and the significance of a "space-time homogeneity axiom" which was used in previous papers are discussed. (auth)

46670 NON-RELATIVISTIC DE SITTER SPACE-TIME AND THE HARMONIC OSCILLATOR. Sudbery, A. (Univ. of York, Heslington, Eng.). Nucl. Phys.; B44: No. 2, 520-30(1972).

A nonrelativistic contraction of the de Sitter group O(3,2) is shown to act as a dynamical group for the three-dimensional harmonic oscillator in a way which preserves many of the features of the relationship between the Galileo group and the free particle. (auth)

46671 ALGEBRAIC STRUCTURE OF A CLASS OF SOLVABLE QUANTUM PROBLEMS. Ghirardi, G. C. (Univ., Trieste, Italy). Nuovo Cim.; 10A: No. 1, 97-120(1 Jul 1972).

A new algebraic approach to the treatment of quantum problems is introduced, which explains completely the algebraic structure of all those systems whose eigenvalue equations can be reduced, by means of proper functional transformations, to the hypergeometric equation. The results obtained constitute therefore the natural extension of the program started previously. In particular, it is proved that the eigenfunctions of the simple but physically interesting differential equation are associated to the states of the irreducible representations $D(\downarrow, \frac{1}{2}[1 + 2g]^{\frac{1}{2}} + l)(l = 0, 1, 2, \ldots)$ of the Lie algebra $A_1 \approx B_1 \approx C_1$, characterized by the fact that the eigenvalue of the generator J_3 of the algebra takes the constant value $\frac{1}{2}[1 + 2g]^{\frac{1}{2}}$ for the considered states. When consideration is given to the S-wave Schrödinger equation for two particles interacting through the Hulthén potential, it is proved that the energy levels are associated with a properly selected submanifold of the space carrying the irreducible representations $D(\uparrow, -1)$ or $D(\downarrow, -1)$ of the same algebra. Finally, a general procedure is introduced which allows an analogous treatment of all problems whose eigenvalue equations can be reduced to the hypergeometric equation. An interesting three-body problem is also exhaustively investigated from the algebraic point of view. (auth)

46672 NONDEGENERATE COMPLEMENTARY SERIES OF REPRESENTATIONS OF THE GROUP $SU_{2,2}$. Macfadyen, N. W. (Cambridge Univ., Eng.). Nuovo Cim.; 10A: No. 2, 268-76 (21 Jul 1972).

Two series of unitary irreducible representations of the nondegenerate complementary series of $SU_{2,2}$ are constructed. They are closely related to the first and second principal series of representations. A third series of irreducible representations, akin to the zeroth (discrete) principal series is also examined; an invariant Hermitian functional is presented, but its positivity could not be determined, and hence the unitarity of the representation. (auth)

46673 MANY-BODY REALIZATION OF THE SCHROEDINGER ALGEBRA. Burdet, G.; Perrin, M. (Centre National de la Recherche Scientifique, Marseille). Lett. Nuovo Cim.; 4: No. 13, 651-5(29 Jul 1972).

It was previously shown that the largest group of space-time transformations which leaves invariant the free Schroedinger equation is a 12-parameter Lie group called Schroedinger group S, which contains the Galilei group G and one 11-dimensional subgroup of Aut (G). The realization of the Schroedinger algebra is given in terms of canonical variables of N particles; this shows that the unitary irreducible representations of the extended Schroedinger group $\bar{S}$ can describe the free system of these N interacting particles, but this extension of the Galilei group strongly limits the form of the interaction between particles compatible with the invariance property under $\bar{S}$. (L.B.S.)

46674 REMARKS ON SOME SYMMETRY PROBLEMS IN COSMOLOGY AND IN THE THEORY OF PARTICLES AND FIELDS. Wataghin, G. (Univ., Turin). Lett. Nuovo Cim.; 4: No. 13, 608-10(29 Jul 1972).

The first group of remarks concerns epochs in which the evolution of the Universe can be described as a quasi-adiabatic expansion. For the zero-mass constituent, like neutrinos and photons, the symmetry problem of the conformal group, and in the 3-dimensional space, of the SO(4) group arises. The second part is concerned with the cut-off problems and the commutation relations. (L.B.S.)

46675 SU(3) UNITARY REPRESENTATIONS. AN ALGERAIC METHOD WITH BOSE OPERATORS. Arisaka, Nakateru (Tohoku Univ., Sendai). Progr. Theor. Phys. (Kyoto); 47: No. 5, 1758-71(May 1972).

The unitary representations of the SU(3) group are investigated in the Fock space defined by the Bose creation annihilation operators a^k, a_i, $b_i^\dagger$ and b^{ik} (i, k = 1, 2, 3). The projection operators are obtained that pick up the vectors in the space of the arbitrary unitary representations of the SU(3) group out of the Fock space. By the use of those projection operators, the canonical basis vectors $|T\mu Y(p,q)\rangle$ are explicitly obtained without the SU(3) C.-G. coefficients. Each normalized isoscalar factor of the SU(3) C.-G. coefficient in the coupling of D(p,0) and D(0,q) is given in terms of the SU(2) C.-G. coefficient. It is seen that all the possible SU(3) transitions between the vectors of the arbitrary irreducible representation spaces occur by applying the irreducible tensor operators in the Fock space. The extension of the Bose operator method to the SU(N) group is performed by introducing Bose creation annihilation operators with totally antisymmetric indices. (auth)

46676 BREAKDOWN OF SYMMETRY IN THE QUANTUM THEORY OF THE NONLINEAR REALIZATION OF A GROUP ON ITS SUBGROUP. Okubayashi, Takao (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 47: No. 5, 1714-21(May 1972).

The intuitively expected violation of symmetry in the quantum theory of preferred field is formulated definitely by constructing the transformation laws of operators in the interaction picture and of the Fock spaces. The components of the current belonging to the homogeneous space are not conserved, and their expectation values exhibit a PCAC-like behavior. The self-energy of the preferred field is explicitly given in the lowest order of perturbation. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstract: 46494.

46677 OPTIMISATION OF POSSIBLE TESTS OF THE VALIDITY OF TIME-REVERSAL. Logan, B. A. (Univ. of Ottawa). Nucl. Instrum. Methods; 102: No. 2, 353-6(1972).

Measurements of the angular correlation of cascade gamma rays from the decay of an oriented nuclear state can be used to test the validity of time-reversal invariance. Reactions induced by polarized proton beams can be used to orient suitable nuclear levels. The characteristics of some possible reactions are dis-

cussed and the relative merits of several suitable cascades are analyzed. (auth)

46678 ALGEBRAIC APPROACH TO THE SOLUTION OF QUANTUM-MECHANICAL PROBLEMS INVOLVING THE INTERACTION OF A CHARGED PARTICLE WITH ELECTROMAGNETIC FIELDS. Beers, B.; Nickle, H. H. (Southern Illinois Univ., Carbondale). Lett. Nuovo Cim.; 4: No. 8, 320-2(24 Jun 1972).

An algebraic approach to the solution of quantum-mechanical problems involving the interaction of a charged particle with various types of electromagnetic fields is described. The method is essentially based on an investigation of the algebra satisfied by the generators of space-time translations, where the usual generators are regarded as being deformed by the presence of the electromagnetic field. (L.B.S.)

46679 LORENTZ TRANSFORMATIONS FOR ELECTROMAGNETIC FIELD VECTORS AND THE MOTION OF CHARGES IN CONSTANT AND HOMOGENEOUS ELECTROMAGNETIC FIELDS. Tarnovskii, A. S. (Kuibyshev State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 63-7(1971). (In Russian).

A surface was established for the region of velocities corresponding to Lorentz transformations which minimize the values of vectors of a specified electromagnetic field. The connection with the Lorentz transformations which do not alter the values of vectors of a given electromagnetic field is revealed. The behavior of field vectors in a system associated with a charge moving in a constant and homogeneous electromagnetic field is examined. Such an electric charge moves in such a manner that the electromagnetic field vectors are decreased, and approach their direction. The transition time was found for a state for which the field vectors in the system associated with the charge are mutually parallel. (tr-auth)

46680 POSSIBLE CPT VIOLATION AND THE $K_L \to \mu^+\mu^-$ DECAY. Achiman, Y. (Univ., Heidelberg). Lett. Nuovo Cim.; 4: No. 10, 437-42(8 Jul 1972).

The puzzle between the value of the conventional unitary lower bound on the rate of $K_L \to \mu^+\mu^-$ and a recent experimental value is examined. Possible CPT violation in the absorptive part of $K_L \to 2\mu$ is examined as a way to resolve this puzzle. (L.B.S.)

Applications (Strong)

Refer also to abstracts: 46482, 46483, and 46611.

46681 (NYO-4076-19) WAVE PACKET REALIZATION OF LIGHTLIKE STATES. Domokos, G. (Johns Hopkins Univ., Baltimore, Md. Dept. of Physics). Jul 1971. Contract AT(30-1)-4076. 14p. Dep. NTIS.

A new realization of lightlike particle states is constructed. The realization considered corresponds to objects which form partially localized wave packets in the space dimensions transverse to the direction of the lightlike momentum. The states of the transverse motion are classified by the representations of an algebra SU(1,1) constructed of the generators of the conformal group. It is conjectured that this realization is suitable for the formulation of the "parton"-model of hadrons. (auth)

46682 MATHEMATICAL CHARACTERIZATION OF THE BREAKING OF HADRONIC INTERNAL SYMMETRY. Abellanas, Lorenzo (Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France). J. Math. Phys. (N. Y.); 13: No. 7, 1064-9(Jul 1972).

The adjoint action of a semisimple complex Lie algebra G singles out some singular directions with special properties. The directions of breaking of the hadronic internal symmetry groups, e.g., SU(3) or SU(3) × SU(3), by the electromagnetic, semileptonic, and nonleptonic weak interactions, are of this type. They are Hermitian (Q,Y) or nilpotent (Cabibbo direction) elements in the corresponding complexified Lie algebra. Their mathematical characterization is provided by the adjoint action of G. In particular, they satisfy a generalized extremal property for every G-invariant polynomial. (auth)

46683 ARE QUARKS POSSIBLE? Dowker, J. S. (Univ. of Manchester, Eng.). Lett. Nuovo Cim.; 4: No, 8, 301-4(24 Jun 1972).

The existence of SU(2) quarks, e.g., nucleons, and the nonobservation of SU(3) quarks are considered. It is pointed out that there is a difference between SU(2) and SU(3) which could account for the absence of SU(3) quarks. This difference is connected with the topological properties of the groups. It is concluded that if elementary particles are quantized kinks on SU(3) they can have only zero triality, giving the eightfold way; thus quarks are excluded. (L.B.S.)

46684 TENSOR MESON PHOTOPRODUCTION AND SU(6) SYMMETRY. Kulish, Yu. V. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 16: No. 9, 1444-9(Sep 1971). (In Russian).

Within the framework of the SU(6) symmetry the processes $\gamma N \to (1^+/2) + 2^+$ and $\gamma N \to (3^+/2) + 2^+$ with the magnetic dipole γ-quanta are considered. It is assumed that the mesons with $J^P = 2^+$ belong to the representation 189 or 405 the SU(6) group. The comparison with the experiment is given. (auth)

46685 MODEL FOR THE MIXING AMONG THE 70 BARYON STATES BASED ON EXCHANGE DEGENERACY. Chiu, C. B.; Mitra, A. N. (Univ. of Texas, Austin). Phys. Lett.; 40B: No. 3, 401-5(10 Jul 1972).

A model for the mixing between the 1^d, 8^d, 8^q, and 10^d states with $J^P = \frac{3}{2}^-$ in the SU(6) 70, L = 1 supermultiplet based on exchange degeneracy conditions of the pseudoscalar meson-baryon scattering is discussed. (auth)

46686 COMMENT ON THE VIRASORO GROUP IN DUAL-RESONANCE MODELS. Ramond, P. (Yale Univ., New Haven). Lett. Nuovo Cim.; 4: No. 10, 422-4(8 Jul 1972).

The finite transformations of the Virasoro group are identified to be maps of periodic functions into periodic functions which leave their average unchanged. In analogy with the SU(2) little group, it is expected that for each observable momentum P_μ, one representation of the Virasoro group exists which classifies the physical states. (L.B.S.)

46687 QUARTET SCHEME OF HADRONS IN CHIRAL U(4) ⊗ U(4). Maki, Ziro; Maskawa, Toshihide; Umemura, Isao (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 47: No. 5, 1682-1703(May 1972).

A general scheme of fundamental quartets is reformulated on the basis of strict lepton-baryon symmetry, and treated in a context of chiral U(4) ⊗ U(4) invariance. The structure of spontaneous breaking of it accompanied by sixteen Nambu-Goldstone bosons is studied in detail. One of the main predictions of the model is the existence of a new 0^--meson, χ, with the mass heavier by ~0.5 GeV than the charmed partners, which may be identified with new heavy particles recently reported by Niu et al. It decays predominantly as $\chi \to K + \bar{K} + (\pi,\eta \text{ or } \eta')$ with small decay widths (~ a few MeV). Such an indication of the existence of new heavy particles is encouraging enough to push forward our new treatment of the fundamental quartets (quartons) as a natural generalization of the Sakata-Nagoya model. (auth)

Field Theories

General

46688 WEYL AND LYRA MANIFOLDS. Sen, D. K.; Vanstone, J. R. (Univ. of Toronto). J. Math. Phys. (N. Y.); 13: No. 7, 990-3(Jul 1972).

It is shown that Weyl's geometry and an apparently similar geometry suggested by Lyra are special cases of manifolds with more general connections. The difference between the two geometries and their relationships with Riemannian geometry are clarified by giving a global formulation of Lyra's geometry. Finally the outline of a field theory based on the latter geometry is given. (auth)

46689 EXACT SOLUTIONS TO THE YANG-MILLS FIELD EQUATIONS. Rosen, Gerald (Drexel Univ., Philadelphia). J. Math. Phys. (N. Y.); 13: No. 5, 595-7(May 1972).

New spatially localized solutions to the Yang–Mills classical field equations are reported. (auth)

46690 HULTHEN AND SCHWARZSCHILD POTENTIALS IN THE KLEIN-GORDON EQUATION. Calucci, G. (Univ., Trieste, Italy. Istituto Nazionale di Fisica Nucleare, Trieste, Italy); Ghirardi, G. C. Nuovo Cim.; 10A: No. 1, 121-31(1 Jul 1972).

The Klein–Gordon equation is discussed and solved for the S-wave in the presence of external fields, for two interesting cases. In the first case the external field corresponds to a short-range potential of the Hulthén type. The second case deals with the Klein–Gordon equation in a spherically symmetric gravitational field, within the framework of general relativity. Some interesting limiting cases of the considered equations as well as of the corresponding energy spectra and S-matrices are discussed. (auth)

46691 N. N. BOGOLYUBOV'S TRANSFORMATION IN THE STRONG COUPLING THEORY. II. Solodovnikova, E. P.; Tavkhelidze, A. N.; Khrustalev, O. A. (Inst. of High Energy

Physics, Serpukhov, USSR). Teor. Mat. Fiz.; 11: No. 3, 317-30(Jun 1972). (In Russian).

N. N. Bogoliubov's transformation considered earlier in the works is generalized to the case of the strong particle-field interaction invariant under arbitrary continuous group of transformations. (auth)

46692 ESSENTIALLY NONLINEAR SCALAR FIELDS AND THE SPACE–TIME GEOMETRY. Nguyen Van Hieu. Teor. Mat. Fiz.; 11: No. 3, 293-300(Jun 1972). (In Russian).

The curving of the space-time in essentially nonlinear fields is studied. The problem of the metrics determination in the field with a given Lagrangian is discussed. It is shown that if the Lagrangian is somehow known beforehand then the measurement of the velocity of signals in the known fields makes it possible to check the predictions of the theory. Another interesting consequence of the curving of space–time is also considered: the universal interaction of all fields with a given essentially nonlinear field. (auth)

46693 Σ^{pq} TENSOR ASSOCIATED WITH THE POLARIZATION QUADRIVECTOR Σ_r AND THE MAXWELL Π^{pq} TENSOR ASSOCIATED WITH THE ENERGY-MOMENTUM QUADRIVECTOR π_r IN COMPLEX FIELDS. Durand, Emile (Univ., Toulouse). Compt. Rend., Ser. B; 274: No. 13, 843-5(27 Mar 1972). (In French).

The Σ^{pq} tensor associated with the polarization quadrivector, σ_r, is defined. It is shown to be a symmetrical universe tensor. The corpuscular character of the plane wave associated with the photon is demonstrated (helicity, mean spin density). (France)

46694 REVISED NONSYMMETRIC UNIFIED FIELD THEORY. Klotz, A. H. (Univ. of Sydney). Acta Phys. Pol.; B3: No. 3, 341-54(1972).

A further development of the Einstein-Kaufman, nonsymmetric unified field theory is discussed. Static, spherically symmetric solutions of the field equations are considered. It is shown that there does not exist a solution corresponding to a magnetic monopole. In the purely electric case, one of Papapetrou's solutions is recovered and a new "cosmological" solution is found in which the space-time metric is that of a flat Minkowski world but a diverging electric field is present. It is pointed out that the theory may be significant as an account of charged matter. (auth)

46695 CYLINDRICAL WAVE SOLUTIONS OF BONNOR'S AND SCHROEDINGER'S UNIFIED FIELD EQUATIONS. Lal, K. B.; Singh, T. (Univ. of Gorakhpur, India). Tensor; 23: No. 2, 151-6(May 1972).

The solutions of Bonner and Schroedinger field equations are found for the case when the electromagnetic field is weak and the case when the electromagnetic field is not necessarily weak. (J.F.P.)

Quantum Field Theory

Refer also to abstracts: 46499, 46514, 46524, 46669, and 46676.

46696 (CONF-710816–19) THIRRING MODEL IN TERMS OF CURRENTS: SOLUTION AND LIGHT CONE EXPANSIONS. Dell'Antonio, G. F. (Naples Univ. (Italy). Istituto di Fisica Teorica); Frishman, Yitzhak (Weizmann Inst. of Science, Rehovoth (Israel); Zwanziger, Daniel (New York Univ., N. Y.). 1971. 51p.

From International symposium on electron and photon interactions at high energies; Ithaca, N. Y. (23 Aug 1971).

Exact expansions of operator products, in terms of C-number functions singular on the light cone and regular operators, are exhibited explicitly in the Thirring model. For the products $\psi_1(x)\psi_1^+(x')$ and $\psi_2(x)\psi_2^+(x')$ of fermion fields the expansion reduces to one term only, with the C-number function having a singularity on the light cone which depends on the coupling constant, and the regular operator depending only on the currents, which are free. The resulting formula allows one to calculate all Wightman functions in terms of current matrix elements and thereby provides a simple and complete solution to the Thirring model. The different charge sectors are realized as inequivalent irreducible representation spaces of the canonical current commutation relations, on which the charged field ψ acts as an intertwining operator. (auth)

46697 (DESY–72/20) CURRENTS, STRESS TENSOR, AND GENERALIZED UNITARITY IN CONFORMAL INVARIANT QUANTUM FIELD THEORY. Mack, G.; Symanzik, K. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Apr 1972. 53p. Dep. NTIS (U. S. Sales Only).

Matrix elements of internal symmetry currents and energy momentum density tensor are constructed in Migdal Polyakov conformal invariant bootstrap field theory. Their 3-point functions satisfy Bethe Salpeter equations which determine any free coefficients that may still occur in the conformal invariant Ansatz. Ward identities are verified for all n-point functions. They imply correct equal time current commutation relations. A proof of generalized unitarity is also given. Various equivalent forms of the propagator bootstrap are discussed. Algebraic techniques also yield an eigenvalue equation for first order correction to the exactly conformal invariant theory, assuming the latter is Gell-Mann Low large momentum asymptote of a renormalizable finite mass theory. (auth)

46698 (ITF–71–128–P) ON THE CHOICE OF A FORM FACTOR IN A NONLOCAL QUANTUM ELECTRODYNAMICS. Efimov, G. F.; Mogilevskii, O. A. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 28p. (In Russian). Dep. NTIS (U. S. Sales Only).

The photon Green function in the approximation of "principal logarithmic diagrams" is investigated in a local quantum electrodynamics. It is assumed that the result of the summation of "principal diagrams" leads to a nonlocal theory. The conditions, under which the Green function derived is unique, are stated. It turns out that any diagrams of perturbation series calculated by means of the partially summed photon Green function are convergent. Within the framework of the proposed procedure the value $l = (1/2m)\exp\{-(3\pi/2\alpha)\} \simeq 10^{-268}$ cm is obtained for an elementary length. (auth)

46699 (JINR–P2–6394) STUDY OF CORRECTIONS TO EIKONAL REPRESENTATION OF AMPLITUDE IN SCALAR FIELD THEORY. Barbashov, B. M.; Nesterenko, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

Based on the approach, called the straight-line paths approximation, the estimate of the high-energy behavior of the first correction term to the eikonal formula in scalar field theory $L_{int} = g\psi^2\phi$ is found. The loss of retardation in the eikonal representation is discussed as well as the connection of this effect with the corresponding approximation of the nucleon propagators. In conclusion, the modification of the eikonal representation, which is due to the introduction of additional interaction of the type $\lambda\phi^4$ is considered. (auth)

46700 (JINR–P2–6437) OPERATOR METHOD OF SOLVING THE QUASIPOTENTIAL EQUATIONS AND A CONCEPTION OF STRAIGHT-LINE PATHS AT HIGH ENERGIES. Kuleshov, S. P.; Matveev, V. A.; Sisakyan, A. N.; Smondyrev, M. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 13p. (In Russian). Dep. NTIS (U. S. Sales Only).

The operator method of solving the quasipotential equations is developed. It is shown that in high energy limit this method, just as the well-known straight-line path approximation in the framework of functional integration methods, is a realization of the general conception of straight-line paths. (auth)

46701 (JINR–P2–6454) QUANTUM FIELD THEORY: "DRESSING" CONTRA DIVERGENCIES. Shirokov, M. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 47p. (In Russian). Dep. NTIS (U. S. Sales Only).

The relativistic theory of charged ψ and neutral φ scalar fields is considered. The interaction $\lambda\psi^+\psi\varphi$ is local, space–time is four-dimensional. Instead of "bare" creation-destruction operators the "dressed" ones are introduced. They have the following main property: "dressed" vacuum and one-particle states must be stable. This property requires in particular that the total Hamiltonian as a function of "dressed" operators must not contain trilinear terms, i.e. terms similar to the interaction ones (terms involving four, five... operators enter instead). The main equation is obtained by equating to zero the sum of all trilinear terms. A reason is presented in favor of the assertion: the equation solutions (if they exist) cannot entail the self-energy divergencies. A necessary condition of existence of the other solutions is obtained. It claims that some integrals involved in the equation must converge nonuniformly and must have some asymptotic property. It is shown that this property can be realized. (auth)

46702 (JINR–P2–6474) LOWER UNBOUNDEDNESS OF THE HAMILTONIAN WITH SCALAR ELECTRODYNAMICS. Zastavenko, L. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 11p. (In Russian). Dep. NTIS (U. S. Sales Only).

A proof of the inconsistency of the conditions, the s-matrix is finite, and the Hamiltonian is bounded from below, is given in the scalar electrodynamics for small values of coupling constant e^2. It follows from this that the ground state for small e^2 and perturbation theory do not exist. (auth)

46703 (JINR-P2-6482) ASYMPTOTIC ESTIMATES OF QUASIPOTENTIAL PARAMETERS. Goloskokov, S. V.; Matveev, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 11p. (In Russian). Dep. NTIS (U. S. Sales Only).

The limitations on the quasipotential parameters which do not violate the absolute inequalities for the physical values proved in the local quantum field theory were obtained. (auth)

46704 (N-72-19766) LORENTZ-INVARIANT FORMULATION OF CHERENKOV RADIATION BY TACHYONS. Jones, Frank C. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Mar 1972. 34p. (NASA-TM-X-65851; X-641-72-73). NTIS.

Previous treatments of Cherenkov radiation, electromagnetic and gravitational, by tachyons were in error because the prescription employed to cut off the divergent integral over frequency is not a Lorentz invariant procedure. The resulting equation of motion for the tachyon is therefore not covariant. The proper procedure requires an extended, deformable distribution of charge or mass and yields a particularly simple form for the tachyon's world line, one that could be deduced from simple invariance considerations. It is shown that Cherenkov radiation by tachyons implies their ultimate annihilation with an antitachyon and demonstrates a disturbing property of tachyons, namely the impossibility of specifying arbitrary Cauchy data even in a purely classical theory. (auth) (STAR)

46705 ALGEBRAIC SOLUTION FOR THE KAELLEN-PAULI STATE VECTORS IN THE Vθ SECTOR BY A CONGRUENCE TRANSFORMATION. Nelson, C. A. (Louisiana State Univ., Baton Rouge). J. Math. Phys. (N. Y.); 13: No. 7, 1051-6(Jul 1972).

From the representation of Bolsterli of the Vθ sector physical states in a basis having singular integral equations of the separable type, a congruence transformation carries the representation into the Källén-Pauli Heisenberg field components. This solves the Källén-Pauli singular integral equation algebraically. The resulting state vectors are proven explicitly to be both complete and orthonormal and furnish a new Möller wave matrix. (auth)

46706 HIGHER ORDER PERTURBATION THEORY FOR EXPONENTIAL LAGRANGIANS: THIRD ORDER. Pohlmeyer, K. (Inst. for Advanced Study, Princeton, N. J.). Commun. Math. Phys.; 26: No. 2, 130-48(1972).

The vacuum expectation value of the time-ordered product of three exponentials of free massless fields is defined as a continuous linear functional over a suitable test function space using minimal singularity as a criterion. (auth)

46707 CONNECTION BETWEEN THE SPECTRUM CONDITION AND THE LORENTZ INVARIANCE OF P(phi)$_2$. Streater, R. F. (Bedford Coll., London). Commun. Math. Phys.; 26: No. 2, 109-20(1972).

It is proved that, for the P(ϕ)$_2$ quantum field theory, the Wightman functions are Lorentz invariant if the energy-momentum spectrum lies in the forward light-cone. The ingredients of the proof are the following facts, established by Glimm and Jaffe: the field satisfies local commutativity, and also the estimates $\phi_V(f,t) \leq$ const $||f||_1(H_V + I)$ and $\pi_V(g,t) \leq ||g||_2(H_V + I)$, where V is a space cut-off, uniformly in V. (auth)

46708 TEST OF QUANTUM-ELECTRODYNAMICAL CORRECTIONS IN MUONIC ATOMS. Walter, H. K.; Vuilleumier, J. H.; Backe, H.; (and others) (CERN, Geneva). Phys. Lett.; 40B: No. 2, 197-9(26 Jun 1972).

Energies of the 5g-4f muonic X-rays were measured in ^{198}Hg and ^{203}Tl with an accuracy of about 25 eV. They are found to be smaller than theoretical energies including recently revised calculations of higher-order vacuum polarization, by about two standard deviations. (auth)

46709 MULTIPOLE RADIATION SOLUTIONS FOR A CLASS OF MASSIVE PARTICLE WAVE EQUATIONS. Hajj, Jack P. (Suffolk Univ., Boston); Weaver, David L. J. Math. Phys. (N. Y.); 13: No. 5, 640-5(May 1972).

The multipole radiation solutions are derived for the integer and half-integer spin massive particle wave equations of Weaver, Hammer, and Good. The rest system and massless limits of the solutions are found, the latter limit being shown to coincide with previous work by the present authors. Finally, as an application, the massive particle description is second quantized in terms of the multipole solutions and compared with some other formulations. (auth)

46710 RECENT DEVELOPMENTS IN THE COMPARISON BETWEEN THEORY AND EXPERIMENTS IN QUANTUM ELECTRODYNAMICS. Lautrup, B. E. (CERN, Geneva); Peterman, A.; de Rafael, E. Phys. Rep.; 3C: No. 4, 193-259(1972).

A survey is given of three main topics in quantum electrodynamics: fundamental bound systems; anomalous magnetic moments and high energy experiments. The emphasis lies particularly in recent developments concerning the electron and muon anomalous magnetic moments. (auth)

46711 CHOICE OF FORM FACTORS IN NON-LOCAL QUANTUM ELECTRODYNAMICS. Efimov, G. V.; Mogilevskii, O. A. (Inst. for Theoretical Physics, Kiev). Nucl. Phys.; B44: No. 2, 541-57(1972).

The photon Green function in the approximation of principal logarithmic diagrams is investigated in local quantum electrodynamics. It is supposed that the result of the summation of principal diagrams leads to a non-local theory. Conditions under which the obtained Green function is unambiguous are stated. It turns out that any diagrams of the perturbation theory series, calculated by means of the partially summed photon Green function, are convergent. Within the frame of the procedure proposed, the value for elementary length is obtained: $l = (1/2m) \exp\{-3\pi/2\alpha\} \approx 10^{-288}$ cm. (auth)

46712 ANALYTIC RENORMALIZATION OF THE EXPONENTIAL INTERACTIONS: THE THREE-POINT TIME-ORDERED PRODUCT WITH MINIMUM LIGHT CONE SINGULARITY. Daniel, M. (Oxford Univ.); Mitter, P. K. J. Math. Phys. (N. Y.); 13: No. 7, 1026-41(Jul 1972).

A method of analytic renormalization is developed to define the three-point time-ordered product of massless fields of exponential type as a strictly localizable distribution. The uniqueness property, known for the two-point T-product, is verified for the three-point product, for a special choice of fine renormalization. It is characterized by minimum singularity on the light cone: There are no delta function type singularities concentrated on the surface $x_1 = x_2 = x_3$. (auth)

46713 EQUIVALENCE OF DRESSING TRANSFORMATIONS. Federbush, Paul (Univ. of Michigan, Ann Arbor). J. Math. Phys. (N. Y.); 13: No. 7, 977-9(Jul 1972).

The equivalence of the representations of the Weyl algebra for ϕ^4_{+1} in a box induced by the dressing transformation of Glimm and the unitary dressing transformation is studied. Equivalence is shown for the simplified model in which only the most singular portion of the interaction is kept. (auth)

46714 POINCARE AND TCP INVARIANCE IN THE DETERMINATION OF WAVE EQUATIONS FOR PARTICLES OF ARBITRARY SPIN. Seetharaman, M.; Mathews, P. M. (Univ. of Madras). J. Math. Phys. (N. Y.); 13: No. 7, 938-43(Jul 1972).

A brief outline is given of different types of approaches to the derivation of relativistic wave equations for free particles of arbitrary mass m and spin s. It is pointed out that all such equations can be subsummed in a standard form involving wavefunctions transforming according to the representation D(0,s) $\oplus$ D(s,0) of the Lorentz group. Generalizing earlier work employing this standard form, all such equations (in a standard form) which are invariant under the Poincaré group and the combined operation $\Theta \equiv$ TCP are determined. It is shown that the resulting equations are automatically invariant under T, C, and P separately. (auth)

46715 REPRESENTATIONS OF THE CCR IN THE $(\phi^4)_3$ MODEL: INDEPENDENCE OF SPACE CUTOFF. Eckmann, Jean-Pierre (Univ., Geneva). Commun. Math. Phys.; 25: No. 1, 1-61(1972).

The algebra of observables for the renormalized ϕ^4 interaction in 3-dimensional space-time is constructed. It is shown that the von Neumann algebras associated with observables in a bounded region B are independent of the space cutoff which is used in the construction of a Hamiltonian for this interaction. This result is shown to be useful in the construction of a translation invariant ϕ^4 theory in three dimensions. It also gives a physical criterion for the equivalence of non-Fock representations of the canonical commutation relations. (auth)

46716 SOME REMARKS ON THE NULL PLANE DEVELOPMENT OF A RELATIVISTIC QUANTUM FIELD THEORY. Schlieder, S.; Seiler, E. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Commun. Math. Phys.; 25: No. 1, 62-72(1972).

Conditions are given for the existence of field operators on so-called null planes, and some consequences of the necessary restriction of the test function space concerning Haag's theorem and the possibility of unitary mappings intertwining between free fields of different masses are discussed. Conditions under which a unitary representation of the dilatations in the null plane gives

rise to a unitary representation of the dilatations in Minkowski space are discussed. (auth)

46717 EQUATION CURL $W_\mu(x) = 0$ IN QUANTUM FIELD THEORY. Pohlmeyer, K. (Inst. for Advanced Study, Princeton, N. J.). Commun. Math. Phys.; 25: No. 1, 73-86(1972).

In one time and arbitrarily many space dimensions necessary and sufficient conditions for the existence of a local operator solution of the equation $\partial_\nu \omega = W_\nu$ are obtained. The given local fields W_ν satisfy $\partial_\mu W_\nu - \partial_\nu W_\mu = 0$, and the spectrum of the two point function $(\Omega, W_\mu(x)\, W_\nu(y)\Omega)$ is assumed to have a mass gap. (auth)

46718 $(\phi^{2n})_2$ FIELD HAMILTONIAN FOR COMPLEX COUPLING CONSTANT. Rosen, Lon; Simon, Barry (Univ. of California, Berkeley. Princeton Univ., N. J.). Trans. Amer. Math. Soc.; 165: 365-79(Mar 1972).

Hamiltonians $H_\beta = H_0 + \beta H_I(g)$, where H_0 is the hamiltonian of a free Bose field $\phi(x)$ of mass $m > 0$ in two-dimensional space-time, $H_I(g) = \int g(x): P(\phi(x)): dx$ where $g \geq 0$ is a spatial cutoff and P is an arbitrary polynomial which is bounded below, and the coupling constant β is in the cut plane, i.e., $\beta \neq$ negative real are considered. It is shown that H_β generates a semigroup with hypercontractive properties and satisfies higher order estimates of the form $||H_0 N^r R_\beta^s|| < \infty$, where N is the number operator, $R_\beta = (H_\beta + b)^{-1}$, r a positive integer, and β, s, and b are suitably chosen. For any $0 \leq \Theta < \pi$, R_β converges in norm to R_0 as $|\beta| \to 0$ with $|\arg \beta| \leq \Theta$. Finally applications of these results are discussed and asymptotic series and Borel summability for various objects in the real β theory are established. (auth)

46719 METHOD OF GAUGE-INVARIANT REGULARIZATION. Ashmore, J. F. (International Centre for Theoretical Physics, Trieste, Italy). Lett. Nuovo Cim.; 4: No. 8, 289-90 (24 Jun 1972).

It is suggested that by using the dimensionality of space-time as a complex parameter as in analytic regularization, a gauge-invariant renormalization could be achieved in a fairly simple manner. This idea is demonstrated in the example of second-order vacuum polarization in quantum electrodynamics. (L.B.S.)

46720 GAUGE PROBLEM IN QUANTUM FIELD THEORY. Mathews, P. M. (Univ. of Madras). Lett. Nuovo Cim.; 4: No. 8, 298-300(24 Jun 1972).

It was proved by Strocchi (Phys. Rev., 162: 1429 (1967)) from the general axioms of quantum field theory that the electromagnetic field tensor $F_{\mu\nu}$ will have to vanish identically if one insists that the potentials A_μ should a) satisfy Maxwell equation as an operator equation, and b) transform strictly as a four-vector under transformations of the Poincare group. This work was criticized by Han and Biedenharn, who claimed that the conclusions are not valid. Comments are made on these works. It is suggested that the reason for the failure to get a nontrivial theory when a) and b) are demanded in the context of the conventional axioms of quantum field theory can be traced to the fact that the representation of the Poincare group according to which the massless vector field transforms is an indecomposable one. (L.B.S.)

46721 BOUND STATES IN QUANTUM ELECTRODYNAMICS. Roy, T. (Jadavpur Univ., Calcutta). Indian J. Phys.; 45: No. 7, 328-36(Jul 1971).

Scattering of electrons, atoms and molecules including the creation-annihilation processes is considered from the point of view of quantum electrodynamics. The separation of the interaction Hamiltonian in the Coulomb part and the rest in the Schrödinger picture yields results which can be subjected to perturbation expansion, yet giving bound states wherever required. Because of the commutation relations proper symmetrizations are obtained even in a complicated case. (auth)

46722 POSSIBLE ORIGIN OF FINITE QUANTUM ELECTRODYNAMICS FROM WEAK INTERACTIONS. Budini, P. (International Centre for Theoretical Physics, Trieste, Italy); Furlan, P. Lett. Nuovo Cim.; 4: No. 8, 305-11(24 Jun 1972).

A method for regularizing quantum electrodynamics with the use of nonpolynomial weak Lagrangians and the concept of a regularizing coupling constant rather than a regularizing mass are examined. The photon constituents are taken to be lepton-antilepton pairs. It is shown that the value of the regularizing coupling constant to give massless vector bound states is of the order of magnitude of the Fermi weak-coupling constant. It is concluded that the idea that electrodynamical interactions are generated by the weak ones and that a finite quantum electrodynamics is originated in this way seems to be a plausible one. (L.B.S.)

46723 EXAMPLE OF A COVARIANT FIELD THEORY OF ELEMENTARY PARTICLES. Efinger, H. J. (Univ. of Otago, Dunedin, New Zealand). Lett. Nuovo Cim.; 4: No. 8, 312-14 (24 Jun 1972).

A brief review is first given of Fierz's model of a soluble field theory, that certain field equations that result from an interaction of a scalar gravitational field with a massless scalar field can be solved exactly. The possibility of generalizing this model to encompass elementary particles of nonzero mass is examined. (L.B.S.)

46724 CASUALITY GROUP IN FINITE SPACE-TIME. Blasi, A. A. (Univ. Genoa. Istituto Nazionale di Fisica Nucleare, Genoa); Gallone, F.; Zecca, A.; Gorini, V. Nuovo Cim.; 10A: No. 1, 19-36(1 Jul 1972).

An axiomatic definition of the relativity group for a finite four-dimensional space-time is given. Causality is represented as a relation on space-time and the relativity group is defined to be the casual group, namely the group of all permutations of space-time which preserve the causal relation. This group is found to be linear (modulo translations) and to contain, along with transformations which are strictly analogous to the usual Poincaré transformations, also transformations which interchange the inner with the outer part of light-cones. These transformations, which seem to set up a favorable framework for the introduction of tachyons, are possible in the real case only for a two-dimensional space-time and have to be introduced ad hoc, while in the scheme which is proposed here they arise naturally. It is further found that in this model the analogue of the orthochronous relativity group of the conventional real case is trivial, since it contains no boosts. (auth)

46725 REGGE POLES FOR LARGE COUPLING CONSTANTS IN THE WICK-CUTKOSKY MODEL. Mueller, H. J. W. (Univ., Trier-Kaiserslautern, Ger.). Nuovo Cim.; 10A: No. 1, 76-86(1 Jul 1972).

Following an initial investigation of Cheng and Wu the solutions of the Wick-Cutkosky model of the Bethe-Salpeter equation are examined in the case of unequal masses in the region of large coupling constants. Two branches of the solution are given covering the entire range of the independent variable. The tight-binding anomalies associated with the ladder approximation are discussed and the Regge trajectories are calculated. It is found that the pomeron trajectory — interpreted as the leading singularity of the "potential" rather than the amplitude — is located at $J > 1$ if the coupling is sufficiently strong. (auth)

46726 FACTORIZATION IN A MULTIPERIPHERAL CONFIGURATION: CAN ONE CONSTRUCT DUAL AMPLITUDES ON MORE GENERAL FIELD THEORY VERTICES AND PROPAGATORS. Lebrun, J. P. (CERN, Geneva). Nuovo Cim.; 10A: No. 1, 132-44 (1 Jul 1972).

Observing a simple connection between the zero-mode contribution in the conventional N-point dual Born term for unit intercept (Virasoro case) and the $\lambda\varphi^3$ field theory, the possibility of constructing a new class of dual amplitudes based on more general field theory couplings and propagators is studied. The resulting amplitudes would have a number of particles suppressed on the leading trajectory, the spin-J ground state in a given channel being built on a two-dimensional operator formalism ("rotational" modes) that treats the integer and half-integer angular momenta in a unified way. The main part of this paper is devoted to a detailed study of factorization on a multiperipheral configuration in terms of "translational" and "rotational" modes. As a preliminary application in the context of dual models of the formalism developed the consequences of a simple factorization ansatz for the vertex into a pure "spin" part and a harmonic-oscillator part are studied. (auth)

46727 CROSSING AND UNITARITY IN THE CONTEXT OF THE BETHE-SALPETER EQUATION. Becker, W.; Grosser, D. (Univ., Tuebigen, Ger.). Nuovo Cim.; 10A: No. 2, 343-61 (21 Jul 1972).

Starting with the crossing-symmetric Bethe-Salpeter equation an approximation scheme for the T-matrix is discussed that consists of a recursive set of linear equations the solutions of which satisfy all symmetry properties of the exact T-matrix. The first of these equations is also derived by functional methods. It is established that in the frame-work of field theory essentially only the exact T-matrix satisfies both crossing symmetry and elastic unitarity, and the way in which the solutions of the equations violate unitarity is discussed. (auth)

46728 METHOD OF CHARACTERISTICS FOR FUNCTIONAL-DERIVATIVE EQUATIONS. Dahmen, H. D. (Institut fuer Theoretische Physik, Heidelberg. Kernforschungszentrum, Karlsruhe, Ger.); Jona-Lasinio, G.; Tarski, J. Nuovo Cim.; 10A: No. 3, 513-20(1 Aug 1972).

The method of characteristics is adapted to first-order functional-derivative equations. The general solution is then found to

three such equations in mathematical physics. Topological questions are not considered. (auth)

46729 ANALYTIC RENORMALIZATION VIA CONTINUOUS SPACE DIMENSION. Cicuta, G. M.; Montaldi, E. (Univ., Milan. Istituto Nazionale di Fisica Nucleare, Milan). Lett. Nuovo Cim.; 4: No. 9, 329-32(1 Jul 1972).

An analytic approach to renormalization is considered for the parametric integral representation for a Feynman integral in a scalar field theory in a space-time with d dimension. The parametric integral representation is extended by allowing the dimension d to take complex values. The renormalized integral is then obtained from an analytic continuation in d. (L.B.S.)

46730 THREE TYPES OF RELATIVISTIC EQUATIONS FOR PARTICLES WITH NONZERO MASS. Fushchich, V. I. (Inst. of Mathematics, Kiev). Lett. Nuovo Cim.; 4: No. 9, 344-6(1 Jul 1972).

It is shown that for free particles and antiparticles with mass > 0 and the arbitrary spin $s \geq \frac{1}{2}$ there exist three types of nonequivalent relativistic equations. (L.B.S.)

46731 CONFORMAL INVARIANCE OF ZERO-MASS KLEIN-GORDON-TYPE EQUATION. Mariwalla, K. H. (Inst. of Mathematical Science, Madras). Lett. Nuovo Cim.; 4: No. 8, 295-7 (24 Jun 1972).

It was recently shown by Bracken that $D^{m,n}_{M=0}$ representations of the Lorentz group that satisfy Klein-Gordon-type equations are not covariant under transformations of the conformal group if $mn \neq 0$. It is pointed out that the proof does not hold if one takes into account additional symmetries and constraints usually associated with these fields. (L.B.S.)

46732 LORENTZ TRANSFORMATIONS: DERIVATION OF LINEARITY AND SCALE FACTOR. Hegerfeldt, G. C. (Univ., Goettingen, Ger.). Nuovo Cim.; 10A: No. 2, 257-67(21 Jul 1972).

A transformation connecting two inertial frames S and S' must transform uniform motion of material bodies into uniform motion. However, since c is an upper bound on velocities, physics merely states that straight lines in the light-cone (and not necessarily all straight lines as for projective transformations) go over into straight lines. Nevertheless, it is shown in a quite elementary way that this weaker property also implies linearity. Constancy of light velocity then gives in a standard way the Lorentz transformations up to a "scale factor" λ which can, in principle, depend on the particular Lorentz transformation Λ and translation a. By a very simple group-theoretical argument it is shown that $\lambda \equiv 1$. (auth)

46733 MEASUREMENT OF AN OPTICAL FREQUENCY AND THE SPEED OF LIGHT. Bay, Z.; Luther, G. G.; White, J. A. (National Bureau of Standards, Washington, D. C.). Phys. Rev. Lett.; 29: No. 3, 189-92(17 Jul 1972).

The measurement of the frequency of the 633-nm red laser line is reported. This is the first measurement of an optical frequency in the visible range without reference to the speed of light or to a measured wavelength. Combination of the optical frequency with the known wavelength yields c to an accuracy higher than previously known. This method demonstrates the practicability of a single-standard time-length measurement system unified via a defined value of the speed of light. (auth)

46734 SUPERLUMINAL FRAMES AND THE GROUP OF GENERALIZED LORENTZ TRANSFORMATIONS IN FOUR DIMENSIONS. Mignani, R. (Univ., Catania, Italy. Centro Siciliano di Fisica Nucleare e di Struttura della Materia, Catania, Italy. Istituto Nazionale di Fisica Nucleare, Catania, Italy); Recami, E.; Lombardo, U. Lett. Nuovo Cim.; 4: No. 13, 624-6(29 Jul 1972).

A new group G of Lorentz transformations in four dimensions generalized for both subluminal ($\beta < 1$) and superluminal ($\beta > 1$) velocities was previously introduced. Comments are given to further clarify the new group, along with comments on the physical laws for tachyons the equivalence of inertial frames. (L.B.S.)

46735 DISPERSION RELATIONS FOR THE VERTEX FUNCTION FROM LOCAL COMMUTATIVITY. II. TWO-DIMENSIONAL DISPERSION RELATIONS. Andersson, B. (Univ. of Lund, Sweden). Commun. Math. Phys.; 25: No. 4, 308-35(1972).

Representation formulas for the vertex function are derived which are valid for arbitrary complex values of two of the scalar variables inside the corresponding domain of holomorphy, while the third variable is evaluated in a neighborhood of positive real values (the corresponding physical-region singularities). The analyticity domains always include at least the corresponding "axiomatic" Källén-Wightman domain. Two alternative versions are given. In the first formula the occurring weight functions are the boundary values of the vertex function along the real axes of the scalar variables. The values of the arguments are such that the boundary values can be expressed in terms of the causal respectively time-ordered functions, which in a well-known way via reduction technique are related to the different form factors of the underlying field theory. In the second formula the weight functions are just the on-mass-shell matrix elements of the field operators which completely describe the dynamics of the theory and e.g., contain explicit information (in their support properties) on the mass spectrum of the field theory. The assumptions behind the results are the very general physical assumptions of Källén and Wightman, i.e., essentially Lorentz-covariance, translation-invariance, "reasonable" mass- and energy-spectrum, and local commutativity. Some moderate integrability- and boundedness-properties of the vertex function are needed. It is shown that the formalism can be extended to cover all cases of at most polynomial increase of the vertex function in asymptotic directions inside the Källén-Wightman holomorphy domain. The kernel functions in the representation formulas can be explicitly seen to result in possible singularities only along the physical-region-cuts, i.e., from the contributions of the corresponding physical states, as well as along the more complicated Källén-Wightman boundary-surfaces of the holomorphy domain, which correspond to the so-called "anomalous cuts." The kernel functions in the second version above are closely connected to simple perturbation theoretical functions. (auth)

46736 DISPERSION RELATIONS FOR THE VERTEX FUNCTION FROM LOCAL COMMUTATIVITY. I. ONE-DIMENSIONAL DISPERSION RELATIONS. Andersson, B. (Univ. of Lund, Sweden). Commun. Math. Phys.; 25: No. 4, 283-307(1972).

Dispersion relations for the vertex function are derived which are valid when two of the scalar variables are arbitrary complex inside certain domains of the product of the complex planes and the third scalar variable is evaluated just below or just above the physical region-cut. The domains of validity of the dispersion relations for the complex variables are domains with three real dimensions and can be described as neighborhoods of the boundaries of the "axiomatic" analyticity region of Källén and Wightman. The discontinuity of the vertex function across the cut-surface in the third variable for such values of the remaining variables is expressed only in terms of the dynamical on-mass-shell matrix elements of the locally commuting field operators. (auth)

46737 RIGGED HILBERT SPACES IN QUANTUM FIELD THEORY: A LESSON DRAWN FROM CHARGE OPERATORS. Antoine, J.-P. (Univ., Louvain, Belg. Univ., Geneva). Helv. Phys. Acta; 45: 77-92(1972).

Motivated by the problem of defining a charge operator, a systematic study is made of several classes of rigged Hilbert spaces suitable for quantum field theory. The result is that (essentially) only one of them satisfies all the requirements, namely $H_{ql} \subset H \subset (H_{ql})'$, where H_{ql} is the well-known space of quasi-local states. It is then shown that, even in the case of a nonconserved current, the charge operator always exists as a continuous operator from H_{ql} into $(H_{ql})'$. (auth)

46738 NONPOLYNOMIAL LAGRANGIANS (HIGHER PERTURBATION ORDERS). Volkov, M. K. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 11: No. 3, 273-87 (Jun 1972). (In Russian).

It is proved that the theory with nonpolynomial Lagrangian remains finite in higher perturbation orders. It is proved also that the S-matrix is unitary in the third perturbation order. The power of increase of amplitudes in an arbitrary perturbation order is found. (auth)

46739 EQUATIONS FOR THE MATRIX ELEMENTS OF THE EUCLIDEAN QUANTUM ELECTRODYNAMICS. Rebenko, A. L. (Inst. of Theoretical Physics, Kiev). Teor. Mat. Fiz.; 11: No. 3, 301-16(Jun 1972). (In Russian).

The equations for the S-matrix elements of Euclidean quantum electrodynamics are obtained. The generating operator of these equations is investigated. On the basis of an analogy between the interaction Hamiltonian and the generating operator one succeeds in proving (under some restrictions put on the form factor) the convergence of the perturbation series for the arbitrary values of coupling constant. (auth)

46740 NOTE ON THE CONSTRUCTION OF THE BOGOLYUBOV SCATTERING OPERATOR IN THE $(:\varphi^4:)_2$ THEORY. Wreszinski, W. F. (Eidgenoessische Technische Hochschule, Zurich). Teor. Mat. Fiz.; 11: No. 3, 331-6(Jun 1972). (In Russian).

A Bogoliubov scattering operator S(g) is constructed for the

$(:\varphi^4:)_2$ theory in the restricted case where the space–time cutoff has a product structure. Unitarity and causality are verified for this S(g). Some problems in generalizing these results to a larger space of test functions are raised. (auth)

46741 QUANTUM THEORY OF PARTICLES WITH SPIN ZERO AND ONE HALF IN EXTERNAL FIELDS. Seiler, R. (Univ. of Pittsburgh). Commun. Math. Phys.; 25: No. 2, 127-51(1972).

The unitary (pseudo unitary) time-evolution operator for a particle with spin half (zero) in an external time-dependent electromagnetic (scalar) field is used to generate a Bogoliubov automorphism on the algebra of the free in field. For the case of an electric external field (scalar field) a finite expression for Ω_{out} is given and the S-matrix constructed. The latter is unitary and implements the Bogoliubov automorphism. Theorems by Shale and Stinespring are rederived. (auth)

46742 IS REGULARIZATION NECESSARY IN VACUUM POLARIZATION CALCULATIONS? Bui-Duy, Q. (Univ. of Montreal). Lett. Nuovo Cim.; 4: No. 10, 407-12(8 Jul 1972).

It is shown that, to all orders in perturbation theory, the vector current associated with the vacuum of a charged-particle motion in a prescribed electromagnetic field can be completely defined with renormalization prescription alone, and that regularization is not necessary. The technique used is the proper-time method developed by Schwinger. (L.B.S.)

46743 EQUAL-TIME AND EQUAL LIGHT-CONE COMMUTATOR BETWEEN THE DILATATION CHARGE AND THE FIELD IN MASSIVE $\lambda\phi^4$-THEORY. Bandelloni, G. (Univ., Genoa. Istituto Nazionale die Fisica Nucleare, Genoa). Lett. Nuovo Cim.; 4: No. 10, 417-21(8 Jul 1972).

The existence of the commutation (D,φ) between the field and the dilatation charge in a field theory perturbative model is discussed in the equal-time and in the equal-light-cone limit. The massive $\lambda\phi^4$ model is used in the treatment. The results show that the equal-time commutator, as a limit of an unequal-time one, has no meaning due to the occurrence of the four dimensional term in the divergence of the dilatation current. (L.B.S.)

46744 RELATIVISTICALLY COVARIANT FORMULATION IN NONLINEAR LAGRANGIAN THEORIES AND FACTOR-ORDERING PROBLEMS. Suzuki, Tsuneo; Hattori, Chuichiro (Nagoya Univ., Japan. Aichi Inst. of Tech., Toyata, Japan). Progr. Theor. Phys. (Kyoto); 47: No. 5, 1722-42(May 1972).

Factor ordering problems in non-linear Lagrangian theories are discussed. It is shown that symmetrization of the Hamiltonian is necessary in order to get the covariant Dyson formula by considering the factor ordering. As a result, there appear terms proportional to $\hbar^2(\delta^3(0))^2$ in the effective Hamiltonian density. In the evaluation of divergent integrals appearing in non-linear theories it is also necessary to take care of the order of integrations. Following the prescriptions thus obtained, Charap's discussions of the soft-pion theorems in chiral dynamics are reexamined in each order of the perturbation expansion. It is concluded that the soft-pion theorems are maintained, order by order, in perturbation theory also under the condition that the factor ordering is completely taken into account. (auth)

46745 TRANSFORMATION PROPERTIES OF OPERATORS IN LOCAL FIELD THEORY. Kikuchi, Kozo (Osaka Univ.); Taguchi, Yukio; Yamamoto, Kunio. Progr. Theor. Phys. (Kyoto); 47: No. 5, 1783-5(May 1972).

The necessity of the normal dependent Hamiltonian in addition to the ordinary Hamiltonian in quantum electrodynamics in the two-dimensional space-time was previously pointed out, which causes the modification of the energy-momentum tensor and hence the generators of the inhomogeneous Lorentz group. It is investigated how the the notion of transformation should be changed on account of the modification of the generators. (auth)

46746 FUNCTIONAL DEFINITION AND CALCULATION OF GLOBAL OBSERVABLES IN NONLINEAR SPINOR FIELD QUANTUM THEORY. Stumpf, H. (Univ., Tuebingen, Ger.). Z. Naturforsch.; 27a: No. 7, 1058-72(Jul 1972).

Nonlinear spinor theory contains unobservable field operators which cannot be identified with free field operators. Therefore for the comparison with experiment a theory of observables for nonlinear spinor fields is required. This theory is developed for global observables by means of a map into functional space, and leads to a functional quantum theory of nonlinear spinor fields. (auth)

46747 REGGEON PERTURBATION THEORY IN A ZACHARIASEN-LIKE MODEL. Ebert, D. (Humboldt Univ., Berlin). Acta Phys. Pol.; B3: No. 3, 355-61(1972).

Gribov's Reggeon graph technique is used to construct a simple Zachariasen-like model with singularities in the j-plane. Decomposing the scattering amplitude into its one-Reggeon-irreducible and reducible parts yields a natural definition of the propagator, the vertex function, the form factor and the renormalization constants of an intermediate Reggeon. (auth)

Gravitation and General Relativity

Refer also to abstracts: 46192, 46193, 46261, 46501, and 46626.

46748 (JINR-P2-6270) BASIC STATE OF A MANY-FERMION SYSTEM, COUPLED BY GRAVITATIONAL LINES. Zastavenko, L. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 13p. (In Russian). Dep. NTIS (U. S. Sales Only).

A quasi-classical system of Fermi particles linked by lines of gravitation allows an asymptotic solution by means of the Thomas–Fermi method. The boundary-value problem for a differential equation is solved, and an expression for the energy of the basic state of a system of fermions is developed. (K.S.W.)

46749 (ORO-3992-94) ON A POSSIBLE REPULSIVE INTERACTION IN UNIVERSAL GRAVITATION. Chiang, C. C.; Dykla, John J.; Hwang, A. E. (Texas Univ., Austin. Center for Particle Theory). Jun 1972. Contract AT(40-1)-3992. 7p. Dep. NTIS.

A recent solution of the Einstein field equations suggests the possibility of a universal repulsive component in gravity. The consequences of such a possibility are examined by considering macroscopic systems, and it is concluded that such a repulsive component in gravity is compatible with the present observational data. (auth)

46750 APPROXIMATE SOLUTION FOR THE STATIC, SPHERICALLY SYMMETRIC METRIC DUE TO A POINT CHARGED MASS IN BRANS–DICKE THEORY. Mahanta, M. N.; Reddy, D. R. K. (Indian Inst. of Tech., New Delhi). J. Math. Phys. (N. Y.); 13: No. 5, 708-9(May 1972).

An approximate solution of the field equations of Brans–Dicke theory is obtained for a static, spherically symmetric metric due to a charged point mass which can be considered to be an analog of the Reissner–Nordstrom metric in Einstein's theory. (auth)

46751 BUBBLE-TIME CANONICAL FORMALISM FOR GEOMETRODYNAMICS. Kuchar, Karel (Princeton Univ., N. J.). J. Math. Phys. (N. Y.); 13: No. 5, 768-81(May 1972).

A functional differential version of the ADM canonical formalism is proposed. The existence of a canonical transformation separating canonical variables into internal coordinates, energy-momentum densities, and two pairs of true dynamical variables is assumed. The evolution of dynamical variables is governed by functional differential Hamilton's equations. They satisfy certain integrability conditions ensuring the internal path independence of dynamical evolution. The change of dynamical variables along any spacelike hypersurface is given by their Lie derivatives. This allows an elimination of $3\infty^3$ components of the Hamiltonian equation, leading to a functional differential Hamilton equation based on a single bubble time. The Hamilton–Jacobi theory is built along the same lines. The formalism is illustrated in the mini-phase-space of the cylindrical Einstein–Rosen wave. (auth)

46752 STRUCTURE OF THE GRAVITATIONAL FIELD AT SPATIAL INFINITY. Geroch, Robert (Univ. of Chicago). J. Math. Phys. (N. Y.); 13: No. 7, 956-68(Jul 1972).

A formalism is introduced for analyzing the structure of the gravitational field in the asymptotic limit at spatial infinity. Consider a three-dimensional surface S in the space–time such that the initial data on S is asymptotically flat in an appropriate sense. Using a conformal completion of S by a single point Λ "at spatial infinity," the asymptotic behavior of fields on S can be described in terms of local behavior at Λ. In particular, the asymptotic behavior of the initial data on S defines four scalars which depend on directions at Λ. Since there is no natural choice of a surface S in a space–time, the dependence of these scalars on S is essential. The asymptotic symmetry group at spatial infinity, whose elements represent transformations from S to other asymptotically flat surfaces, is introduced. It is found that this group, which emerges initially as an infinite-dimensional generalization of the Poincaré group, can be reduced to the Lorentz group. A set of evolution equations is obtained: These equations describe the behavior of the four scalars under the action of the asymptotic symmetry group. The four scalars can thus be considered as fields on a three-dimensional manifold consisting of all points at spatial infinity. The notion of a conserved quantity at spatial infinity is defined, and, as an example, the expression for the energy-momentum at spatial infinity is obtained. (auth)

46753 CANONICAL DYNAMICS OF SPINNING PARTICLES IN GRAVITATIONAL AND ELECTROMAGNETIC FIELDS. Kuenzle, H. P. (Univ. of Alberta, Edmonton). J. Math. Phys. (N. Y.); 13: No. 5, 739-44(May 1972).

In terms of the canonical form and the connection form on the bundle of Lorentz frames P over a space–time manifold V, a presymplectic form ω is defined on P, which induces a Poisson bracket on the set of real valued functions on the phase space of the system representing a spinning particle in an exterior gravitational and electromagnetic field. This structure coincides with the unique Poincaré invariant one for the free particle. Moreover, the projections into V of the integral manifolds of the kernel of ω on P yield precisely the world lines of a spinning particle as obtained for the dipole approximation of Dixon's equations of motion for extended test bodies in general relativity. (auth)

46754 TACHYON DUST METRIC IN GENERAL RELATIVITY. Foster, J. C. Jr.; Ray, J. R. (Clemson Univ., S. C.). J. Math. Phys. (N. Y.); 13: No. 7, 979-82(Jul 1972).

Special relativity allows the possibility of a class of particles, called tachyons, which travel with speeds greater than the speed of light in vacuum. These particles have spacelike 4-velocities. Since tachyons have energy and momentum, they will contribute to the gravitational field through the energy–momentum tensor. One question then is what types of solutions to the Einstein field equations will tachyons yield. A metric is considered which admits a four-parameter isometry group. When this metric is used in the field equations using a dust energy–momentum tensor, solutions exist only for spacelike 4-velocity of the dust. These are interpreted as solutions for a tachyon dust. Exact solutions to the field equations are obtained. (auth)

46755 GRAVITATIONAL FIELDS WITH GROUPS OF MOTIONS ON TWO-DIMENSIONAL TRANSITIVITY HYPERSURFACES IN A MODEL WITH MATTER AND A MAGNETIC FIELD. Shikin, I. S. (Moscow State Univ.). Commun. Math. Phys.; 26: No. 1, 24-38(1972).

For gravitational fields with metrics which admit of groups of motions multiply—transitive on 2-dimensional space-like invariant varieties, the exact solutions of the Einstein gravitational equations are given for the case when the sources of the gravitational field are dust-like matter and a magnetic field. A magnetic field is oriented along a direction orthogonal to transitivity hypersurface. The solutions contain arbitrary functions. In the case of transitivity hypersurface of positive curvature and in the absence of a magnetic field, the solution is reduced to the Tolman spherically symmetric solution for dust-like matter. The conditions are studied under which the solutions with a magnetic field become asymptotically isotropic and approach the flat and the open Friedmann models. The case of transitivity hypersurfaces with signature (+–) is also considered. (auth)

46756 ENERGY–MOMENTUM DETERMINATION IN THE GENERAL THEORY OF RELATIVITY. Zhelnorovich, V. A. (Moscow State Univ.). Dokl. Akad. Nauk SSSR; 201: No. 5, 1078-81(11 Dec 1971). (In Russian).

The assumption is made that the components of a pseudotensor or of an energy-momentum complex in a continuous medium (a field) are in a closed region, bounded by a piecewise continuous surface. The ensuing mathematical development is related to equations of Einstein, Meller–Mitskevich, and Lichnerowicz. (K.S.W.)

46757 NATURE OF GRAVITATIONAL SYNCHROTRON RADIATION. Chitre, D. M.; Price, Richard H. (Univ. of Utah, Salt Lake City). Phys. Rev. Lett.; 29: No. 3, 185-8(17 Jul 1972).

Ultrarelativistic geodesic particle orbits in the Schwarzschild geometry produce radiation (GSR) with angular distributions like that of synchrotron radiation. The spectra of high-frequency scalar, electromagnetic, and gravitational GSR are compared to each other and to the spectrum of synchrotron radiation. The differences among the spectra are explained in terms of the shape of the effective potential for GSR and the inapplicability of geometric optics. (auth)

46758 VARIATIONAL PRINCIPLES AND SPATIALLY-HOMOGENEOUS UNIVERSES, INCLUDING ROTATION. MacCallum, M. A. H.; Taub, A. H. (Univ. of California, Berkeley). Commun. Math. Phys.; 25: No. 3, 173-89(1972).

The validity of imposing spatial homogeneity on the variations in the usual action principle for Einstein's equations is studied. It is proved that with this procedure the standard and ADM Lagrangians give correct Einstein equations if and only if the space belongs to Class A of Ellis and MacCallum, i.e., the structure constants of the simply transitive group satisfy $C^f_{fg} = 0$. The possibility of overcoming the difficulty in the Class B spaces is examined. (auth)

46759 HOMOGENEOUS ANISOTROPIC SOLUTIONS OF EINSTEIN EQUATIONS WITH A COSMOLOGICAL TERM. Aman, E. G. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 117-20(1971). (In Russian).

A homogeneous, anisotropic model of the universe was obtained with planar, attendant space, filled with a powdery substance, taking into account the Λ-term. The presence of this term, independently positive or negative, accelerates the isotropisation of the solution. (tr-auth)

46760 GRAVITATIONAL ENERGY EMITTED BY AN ISOLATED MATERIAL SOURCE. I. Silenko, P. N. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 101-4 (1971). (In Russian).

The solution of the Einstein field equation was examined for the case of axial symmetry, obtained by van der Brugge in 1966. Assuming that space–time everywhere is void outside of the time-like cosmic tube, which contains all field sources, the point of interest here is the empty realm of space–time. Using the tetrad formalism, the energy and momentum of the system were found, and it was shown that a gravitational radiation exists within the system. (tr-auth)

46761 COSMOLOGICAL TERM, SCREENING OF GRAVITATION, AND THE HYPOTHESIS OF NEGATIVE MASSES. Baranov, A. A. Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 118-20(1971). (In Russian).

A cosmological model is proposed which introduces the concepts of particles of both positive and negative masses, and assists in explaining the phenomenon of interacting galaxies and the screening effect caused by the presence of negative mass. The term $\Lambda = \rho_0/2 \times 8\pi\ G/c^2$ emerges from the theory, where G is Newton's gravitational constant. The density of positive matter ρ_0 is assigned two different values for purposes of discussion: 5×10^{-29}, and 5×10^{-31} g/cm^3. Other constants derived from these values indicate that with density changes of positive matter within the generally accepted limits, the value of the masses of gas from minus-particles with a temperature $-3°$K varies from the mass of the electron to the mass of the muon. (K.S.W.)

46762 SOLUTION OF THE EINSTEIN EQUATIONS WITH A NULL BUNDLE. III. Dozmorov, I. M. (Moscow Higher Technical School). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 76-81(1971). (In Russian).

The transformation of a Kerr–Schild type of null bundle was employed for obtaining new, accurate solutions to Einstein–Maxwell equations from known stationary solutions in a vacuum. Among these is the Kerr solution which describes the gravitational field of a homogeneous, rotating ring. (tr-auth)

46763 SOLUTION OF THE EINSTEIN EQUATIONS WITH A NULL BUNDLE. II. Dozmorov, I. M. (Moscow Higher Technical School). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 68-76(1971). (In Russian).

The possibility of obtaining new accurate solutions to Einstein equations in a vacuum, and to the Einstein–Maxwell equations already known solutions, using a transformation with a null type bundle, was explored. The change in algebraic properties was analyzed for such a transformation in space permitting a congruence of isotropic, geodesic, with null distortion and rotation. Concrete examples illustrating the new, accurate solutions are presented. (tr-auth)

46764 CHARACTERISTIC DEVELOPMENT OF TRAPPED SURFACES IN EINSTEIN-SCALAR SPACETIMES. Demmie, Paul Norman. Pittsburgh; Univ. of Pittsburgh (1971). 164p. University Microfilms Order No. 72-18,105.

Thesis.

The concept of a trapped surface provides for a precise characterization of gravitational collapse which has proceeded beyond the point of no return. Since there is no compelling reason to assume that trapped surfaces always develop during gravitational collapse, an important problem arises concerning the determination of the data required to be given on a null hypersurface in order that they develop in certain spacetimes. An investigation based on the general theory of relativity of this problem of the characteristic development of trapped surfaces was undertaken in this thesis for Einstein-scalar spacetimes. The main results of this investigation are the conditions on the characteristic data sufficient for trapped surfaces to develop in both spherically symmetric Einstein-scalar spacetimes which either contain or do not contain a non-diverging null hypersurface. An important further result of this investigation is the evidence presented supporting a relationship between a certain piece of the characteristic data and angular momentum. (Diss. Abstr. Int., B)

46765 MANY-BODY FORCES AND THE EFFECT OF THE MATTER DISTRIBUTION IN THE UNIVERSE TO THE GRAVITATIONAL CONSTANT. Hiida, K. (Tokyo Univ.). Lett. Nuovo Cim.; 4: No. 10, 398-400(8 Jul 1972).

The importance of the effects due to gravitational many-body forces on the observed gravitational constant is pointed out. The three-body problem is considered and the effects are discussed within the framework of the Minkowski space, considering curvature effects as interactions. The contributions from the Earth, the Sun, the Galaxy, and the Universe for the test bodies on the surface of the earth are estimated. Implications for a model of the expanding Universe are indicated. (L.B.S.)

46766 GAUGE TRANSFORMATION AND GRAVITATIONAL POTENTIALS. Hiida, Kichiro; Okamura, Hiroshi (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 47: No. 5, 1743-57(May 1972).

It is believed in particle physics that the velocity-dependent part of potential is, in general, ambiguous as far as it is derived from S-matrix. The most general form of the graviton propagator is considered under an arbitrary q-number gauge transformation for the graviton field. The propagator depends on twelve arbitrary functions of k^2, k being the space part of the momentum of the graviton. The arbitrariness of the gauge functions can be used to remove the ambiguity of one-graviton exchange potential up to the order of $(G/r)\,(v/c)^4$, G being the gravitational constant. The potential thus obtained depends only on one gauge parameter, say x. The perihelion motion of two-body system is gauge independent, although the potentials in the order of $(G/r)\,(v/c)^2$ and G^2/r^2 depend on the gauge parameter x. The potentials are derived from those in a fixed gauge parameter x by a coordinate transformation. (auth)

46767 MODEL FOR PARTICLES WITH SPIN IN THE GRAVITATIONAL AND ELECTROMAGNETIC FIELD. Duval, Christian; Fliche, Henri-Hugues; Souriau, Jean-Marie (Univ., Aix-Marseille). Compt. Rend., Ser. A; 274: No. 13, 1082-4(27 Mar 1972). (In French).

A model is constructed for particles with spin. The model is consistent with experimental results and the principles of symplectic mechanics and general relativity. It contains an arbitrary function $m(\alpha)$ which may be experimentally determined. (France)

46768 ELASTIC EXCITATIONS EXCITED BY GRAVITATIONAL WAVES. Papapetrou, A. (Univ., Paris). Ann. Inst. Henri Poincare, Sect. A; 16: No. 1, 63-78(1972). (In French).

The general relativistic equation of the motion of a continuous material distribution combined with the relativistic equation of elasticity leads to the equation of elastic waves which determines the vibrations of an elastic body induced by a gravitational wave. (France)

46769 INTEGRATION OF THE NEWMAN–PENROSE EQUATIONS IN A MINKOWSKI SPACE. Pons, Roland (Univ., Paris). Ann. Inst. Henri Poincare, Sect. A; 16: No. 1, 51-62(1972). (In French).

The Newman–Penrose equations are integrated in Minkowski space. The Bondi–Metzner transformations are studied in a Minkowski space having axial symmetry and the radial Newman–Penrose coordinate. (France)

46770 COVARIANT CANONICAL EQUATIONS OF THE TEST-PARTICLE MOTION IN GENERAL RELATIVITY. Pyragas, Kazimiras A. (Inst. for Theoretical Physics, Kiev). Tensor; 23: No. 2, 241-9(May 1972).

The canonical equations of motion are derived in a covariant form by a direct generalization of the Hamiltonian variational principle. Also the notion of correspondence of the points on a set of curves is discussed. (J.F.P.)

46771 SPECIAL CLASS OF STATES OF TOTAL PURE RADIATION IN GENERAL RELATIVITY. Zund, J. D. (New Mexico State Univ., Las Cruces). Tensor; 23: No. 2, 144-6 (May 1972).

A special class of solutions of the Lichnerowicz radiation equations and the Maxwell equations for a singular source-free electromagnetic field are shown for a nonspecial recurrent space-time. (J.F.P.)

46772 NEUTRINOS IN SPHERICALLY SYMMETRIC GRAVITATIONAL FIELDS. Audretsch, J. (Queen Elizabeth Coll., London). Lett. Nuovo Cim.; 4: No. 9, 339-43(1 Jul 1972).

The solutions ψ of the Weyl equation for neutrino interactions with gravitational fields are studied in the general spherically symmetric space-time without restrictions on the metric. It is shown that in any spherically symmetric space-time, the Weyl equation describing neutrinos has no solution apart from the trivial one ($\psi \equiv 0$) under certain constraints. (L.B.S.)

Scattering Theory

Refer also to abstracts: 46699, 46727, 46738–46741, 46747, 47068, and 47284.

46773 (CTH-ITP-71-17) BREAKDOWN OF SIMPLE CANCELLATION IN THE OPERATOR MULTIPLE SCATTERING SERIES. Karlsson, B. R.; Namyslowski, J. M. (Chalmers Tekniska Hogskola, Goteborg (Sweden). Institutionen for Teoretisk Fysik). 19 Jul 1971. 6p. Dep. NTIS (U. S. Sales Only).

The Watson multiple scattering series is considered for a three-body problem in the eikonal approximation. The sum of the series, i.e. the off-shell Faddeev–Lovelace transition amplitude, is expressed entirely in terms of off-shell two-body transition amplitudes. The result shows that the simple cancellation that occurs in the eikonal multiple scattering series for the on-shell amplitude breaks down for the off-shell amplitude. (auth) (Sweden)

46774 (ITF-72-44-E) THRESHOLD BEHAVIOUR OF DAMA. Bugrii, A. I.; Enkovskii, L. L.; Kobylinskii, N. A. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 11p. Dep. NTIS (U. S. Sales Only).

The threshold behavior of a dual amplitude with Mandelstam analyticity (DAMA) is investigated. The behavior of the trajectory associated with the amplitude is consistent with the threshold behavior following from the potential scattering and also from unitarity and the Mandelstam representation. (auth)

46775 (JINR-P2-6393) S-MATRIX UNITARITY IN THEORIES WITH NONPOLYNOMIAL LAGRANGIANS. Volkov, M. K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 18p. (In Russian). Dep. NTIS (U. S. Sales Only).

Unitarity of S matrix in the third order of perturbation theory in G in nonpolynomial theories is proved. The role of anomalous singularities is cleared up. The scattering amplitude in the fourth order in G is also considered. (auth)

46776 (JINR-P2-6442) INVESTIGATION OF LARGE ANGLE SCATTERING IN QUASIPOTENTIAL APPROACH. Goloskokov, S. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 15p. (In Russian). Dep. NTIS (U. S. Sales Only).

The solution of the quasipotential equation in the quasipotential approximation was found. The estimates of the large-angle scattering amplitude at high energies for the exponential-type quasipotential were obtained. (auth)

46777 PROBABILISTIC INTERPRETATION OF THE QUANTUM SCATTERING CROSS SECTION. Babbitt, Donald G. (Univ. of California, Los Angeles). J. Math. Phys. (N. Y.); 13: No. 5, 637-40(May 1972).

The probabilistic interpretation of the quantum scattering cross section in the case of potential scattering is discussed in terms of Poisson random measures on the impact parameter plane and the sphere of outgoing directions. (auth)

46778 SOME FORMAL DEVELOPMENTS ON THE EIKONAL TREATMENT OF PRODUCTION PROCESSES. Calucci, G. (Univ., Trieste, Italy. Istituto Nazionale di Fisica Nucleare, Trieste, Italy). Nucl. Phys.; B44: No. 2, 629-38(1972).

A treatment of the eikonal formalism for production processes is presented in which a formal solution for the collision problem, analogous to the S-matrix construction in the interaction picture, is obtained. Examples in which the formal solution allows a non-perturbative calculation of the transition amplitudes are shown. (auth)

46779 PRACTICAL RELATIVISTIC THREE-PARTICLE THEORY WITH ARBITRARY PARTICLE INTERACTIONS. Weiss, U. (Univ., Stuttgart). Nucl. Phys.; B44: No. 2, 573-93(1972).

Relativistic three-particle equations are established by the rules of Blankenbecler and Sugar, which put the intermediate particles on the mass shell. By use of the Wightman–Gårding momenta the correct cluster properties and time-reversal invariance are preserved and a spurious $s = 0$ singularity is avoided. A reduction to effective multichannel two-particle equations which is not restricted to separable potentials is discussed. The approach admits the systematical application of perturbation theory to relativistic composite particle scattering problems. (auth)

46780 TIME-DEPENDENT AND TIME-INDEPENDENT POTENTIAL SCATTERING FOR ASYMPTOTICALLY COULOMB POTENTIALS. Marchesin, Dan; O'Carroll, Michael L. (Pontificia Univ. Catolica, Rio de Janeiro). J. Math. Phys. (N. Y.); 13: No. 7, 982-90(Jul 1972).

The three-dimensional quantum mechanical problem of nonrelativistic potential scattering is considered, where the Hamiltonian is $H_2 = H_1 + V = H_0 + V_c + V$; H_0 is the free particle Hamiltonian, V_c is the Coulomb potential, and $V(x)$ is a real-valued potential function defined for $x \in R^3$. The existence of the wave operators $W_\pm(H_2,H_D) = s\text{-}\lim e^{iH_2t}e^{-iH_D(t)}$ on $L^2(R^3)$ for $V = V_2 + V'$ is shown, where $V_2 \in L^2(R^3)$, $V' \in L^\infty(R^3) \cap L^p(R^3)$ $(p < 3)$, and $e^{-iH_D(t)}$ is the family of unitary operators used by Dollard to show the existence of the wave operators $W_\pm(H_1,H_D)$ appropriate for the pure Coulomb case. If V is spherically symmetric then $W_\pm(H_2,H_D)$ are shown to be absolutely continuous complete. If in addition $V(r)$ is continuous in $(0,\infty)$, then $W_\pm(H_2,H_D)$ are continuous complete. In both cases $S = W_+^\dagger W_-$ is unitary. The connection between the more physical, time-dependent wave operator approach and the traditional time-independent method is made, and phase shift formulas are obtained for the wave and scattering operators. (auth)

46781 NONRELATIVISTIC TIME-DEPENDENT SCATTERING THEORY AND VON NEUMANN ALGEBRAS. I. SINGLE CHANNEL SCATTERING. Zachary, W. W. (Naval Research Lab., Washington, D. C.). J. Math. Phys. (N. Y.); 13: No. 5, 609-15 (May 1972).

For single-channel nonrelativistic time-dependent scattering an analysis is made of the von Neumann algebras $M_\pm$ generated by the wave operators $\Omega_\pm$ and the algebra B generated by the spectral projections of both the total and free Hamiltonians. Each of the algebras $M_\pm$ is the direct sum of an Abelian algebra and a factor of type I_∞, but both summands need not occur. For a large class of central potentials B is the direct sum of a countable number of factors of type I_∞ and its commutant the direct sum of a countable number of finite factors of type I. In the latter case the type of each direct summand is uniquely determined by the angular momentum of the corresponding partial wave. Similar decompositions are obtained for algebras related to B and B′ in a natural way that have certain connections with the absolutely continuous and point spectra of the total Hamiltonian. The structure of some algebras related to $M_\pm$ is connected with certain properties of the bound states. (auth)

46782 SOLUTION OF FADDEEV EQUATIONS FOR A ONE-DIMENSIONAL SYSTEM. Majumdar, Chanchal K. (Tata Inst. of Fundamental Research, Bombay). J. Math. Phys. (N. Y.); 13: No. 5, 705-8(May 1972).

Exact solutions are derived for the Faddeev equations for a one-dimensional system of three distinguishable particles of identical mass, interacting pairwise through a delta function potential. The method employed here uses scattering boundary conditions directly on the system of equations. (auth)

46783 SCATTERING THEORY IN FOCK SPACE. Prugovecki, Eduard (Univ. of Toronto). J. Math. Phys. (N. Y.); 13: No. 7, 969-76(Jul 1972).

It is shown that the wave operators which can be introduced in quantum field theories with cutoff interactions can be represented by wave transformers acting on states represented by statistical operators. Integral representations can be found for these wave transformers, which then form the basis of a time-independent scattering theory for such quantum field theories. It is pointed out that this leads to a time-independent perturbation theory in Fock space. (auth)

46784 COMPLETE SOLUTION OF THE INVERSE SCATTERING PROBLEM AT FIXED ENERGY. Sabatier, Pierre C. (Univ., Montpellier, France. Indiana Univ., Bloomington). J. Math. Phys. (N. Y.); 13: No. 5, 675-99(May 1972).

Let D be the class of functions which are bounded by $Cr^{-1+\epsilon}$ and $Cr^{-3-\epsilon}$, E the class of potentials $V(r)$ such that $V(r)$, $rV'(r)$, and $r^2V''(r)$ belong to D. E is dense in the class of potentials γ with finite norm $\int_0^\infty \rho|V(\rho)|d\rho$ in which almost all the results of potential scattering are derived. A complete solution of the inverse scattering problem at fixed energy is given in a class $\tilde{E}$ of potentials which contains E. This means that given any set of phase shifts bounded by $Cl^{-1-\epsilon}$, all the potentials of $\tilde{E}$ which fit this set of phase shifts are constructed. They depend on an arbitrary function. The fundamental tool in the solution is the "scattering structure function." The method is derived in such a way that an approximation theory and numerical computations are feasible. These, together with various studies of the solutions, are the object of forthcoming papers. (auth)

46785 FREE RIEMANN–GREEN'S FUNCTION OF THE INVERSE PROBLEM OF SCATTERING THEORY. Gugushvili, E. I.; Mentkovskii, Yu. L. (Inst. of Theoretical Physics, Kiev). Nuovo Cim.; 10A: No. 2, 292-302(21 Jul 1972).

A closed expression for the free Riemann–Green's function of the inverse problem of scattering theory is obtained which is rigorously valid for arbitrary complex angular momentum l. An estimate (from above) for this function is given. The spectral representation of the free Riemann–Green's function which was formally obtained in a previous paper is rigorously derived. (auth)

46786 SOLUTION OF THE STANDING-WAVE INTEGRAL EQUATION. Minelli, T. A.; Zardi, F. (Univ., Padua). Nuovo Cim.; 10A: No. 2, 362-78(21 Jul 1972).

The standing-wave integral equation is considered in the complex momentum plane. This equation is solved, and the solution is used to inquire about some properties of the reactance matrix. As an illustrative application, the pole expansion of the reactance matrix and the two-potential problem are then investigated. (auth)

46787 NUMERICAL ASPECTS OF MOMENTUM-SPACE SCATTERING EQUATIONS FOR PEAKED POTENTIALS. Adelberg, Michael L.; Saperstein, Alvin M. (Wayne State Univ., Detroit). J. Comput. Phys.; 9: No. 3, 398-411(Jun 1972).

Several programing techniques are suggested for solving partial wave scattering equations in momentum space when the potential matrix, as a function of momentum variables, is strongly peaked about the scattering singularity. In particular, an algorithm is described that makes use of the second Born approximation to estimate error in performing principal value quadratures. For a given required accuracy, one obtains a region of integration about the singularity and a Gauss–Legendre quadrature on this region whose truncation error equals the error due to discarding the region away from the singularity and whose order is much lower than that required by full region quadrature to get the same accuracy. Considerable saving in computer time is achieved. (auth)

46788 INVERSE PROBLEM OF SCATTERING THEORY AND RIEMANN'S METHOD. Gugushvili, E. I.; Mentkovskii, Yu. L. (Inst. of Theoretical Physics, Kiev). Nuovo Cim.; 10A: No. 2, 277-91(21 Jul 1972).

By extending Riemann's method to the case of unbounded domains, a new rigorous approach to the inverse problem of scattering theory is developed. The proposed approach allows one to deal with scattering of both charged and neutral particles in the framework of a universal scheme which is also suitable for treating both real- and complex-angular-momentum cases. (auth)

46789 S-MATRIX POLE TRAJECTORIES IN THE N/D APPROACH. Kok, L. P.; van der Ploeg, F. A.; Greben, J. M. (Univ., Groningen, Netherlands). Phys. Lett.; 40B: No. 3, 300-4(10 Jul 1972).

Solutions of the N/D equations in potential scattering are described for some specific local interactions for which the left hand singularities are poles (exponential, Hulthén potential). The quality and the anomalies of the resulting approximate solutions are discussed in detail. (auth)

46790 EXACT STATIONARY SOLUTIONS FOR THE CLASSICAL RELATIVISTIC THREE-PARTICLE PROBLEM. Chern, De-ching. Philadelphia; Temple Univ. (1972). 150p. University Microfilms Order No. 72-17,683.

Thesis.

The existence of certain exact solutions of the nonrelativistic three-body problem was recently shown by Havas. The solutions describe 3 particles revolving around a common axis with the same angular velocity; the configuration is fixed in a plane which also contains the axis of rotation. In this thesis, the corresponding relativistic problem is investigated for electromagnetic, scalar and vector meson interactions. Radiation is excluded by assuming that the interactions are time-symmetric. Equations of motion derived from both field theory and the theory of action at a distance are considered. The existence of exact solutions of the above type is established. These include the relativistic generalization of Havas' solutions, as well as some highly relativistic motions without nonrelativistic counterpart. However, the latter are shown to be not verifiable experimentally with known particles and interactions. (Diss. Abstr. Int., B)

46791 HIGH ENERGY PRODUCTION PROCESSES IN THE RELATIVISTIC EIKONAL APPROXIMATION. Tanaka, Syu. Philadelphia; Univ. of Pennsylvania (1971). 79p. University Microfilms Order No. 72-17,429.

Thesis.

For high energy production processes, the factorization properties of inelastic effects on the elastic amplitude are studied, first by the eikonal approximation method in a perturbative approach (without assuming the momentum of a produced particle is small), and second by functional methods for many- but soft-particle production. The latter corresponds to the situation in the Bloch–Nordsieck model. (Diss. Abstr. Int., B)

46792 MULTIPLE-SCATTERING EXPANSION AND THE GLAUBER APPROXIMATION. Yamazaki, Masakatsu (Tokyo

Inst. of Tech.). Progr. Theor. Phys. (Kyoto); 47: No. 5, 1593-1600(May 1972).

In potential theory a general derivation of the Glauber approximation from the multiple scattering expansion is given by making the high-energy small-angle approximation in Green's function. The problem is treated in coordinate representation. This treatment makes the derivation easier than that of Harrington does. It is found that each sub-reaction matrix which consists of a different number of connected parts of the total reaction matrix is reduced to the corresponding Glauber term at high energies. (auth)

46793 RELATIVISTIC SCATTERING OF PARTICLES WITH SPIN. Barthelemy, M. C. (Univ., Angers, France); Jolivet, Andre. Compt. Rend., Ser. A; 274: No. 13, 1078-81(27 Mar 1972). (In French).

The Faxen–Holtzmark method is generalized in the framework of a relativistic theory for particles with spin. The system of partial differential equations describing the particles is irreducible, linear of the first order, of finite rank and has a covariant form with respect of the Poincare group. A general formula is given for the scattering amplitude. (France)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

Refer also to abstract: 47299.

46794 ENERGY FLUX BETWEEN TWO SUPERFLUID HELIUM BATHS SEPARATED BY A THIN LAYER. Seiden, Joseph (Univ. Paris, Orsay, France). Compt. Rend., Ser. B; 274: No. 18, 1049-52(3 May 1972). (In French).

The energy flux crossing a thin metal layer separating two superfluid helium baths at different temperatures was calculated. The results were applied to experiments performed by Challis and Sherlock. (France)

46795 PHONON DISPERSION AND CONTRIBUTION TO THE HEAT CAPACITY IN LIQUID ^{4}He. Yamada, Kazuo; Ishikawa, Koki (Nagoya Univ., Japan). Progr. Theor. Phys. (Kyoto); 47: No. 5, 1455-63(May 1972).

The temperature-dependent shift of the phonon excitation spectrum in liquid ^{4}He, based on the phonon interactions in quantum hydrodynamics, is calculated over a wide range of momentum. It is found that in a small-momentum limit, the result is in agreement with previous papers, and in a large-momentum limit, the shift decreases logarithmically with increasing momentum and turns into a negative value beyond a critical momentum. Further, a correction term to the specific heat, necessary because of this temperature-dependent shift of the spectrum and giving a deviation from the T^3 law, is evaluated from the lowest-order thermodynamical potential. The predicted contribution is proportional to T^7 and results in negligible magnitude at low temperature and pressure compared with the term γ-T^5, which is dominant in the analysis of the experiments for the heat capacity by Phillips et al. As a result, the positive dispersion ($\gamma < 0$) at zero temperature was not altered by the evaluation obtained here. (auth)

46796 CONSEQUENCES OF MICROSCOPIC SYMMETRIES AND LINEAR RESPONSE THEORY FOR THE HYDRODYNAMICS OF SUPERFLUID HELIUM. Fryer, Michael Owen. Seattle; Univ. of Washington (1972). 94p. University Microfilms Order No. 72-20,865.

Thesis.

The hydrodynamic properties of liquid He II are analyzed. It is noted that these properties may be described by two-fluid hydrodynamics and by quantum statistical mechanics. By insisting that the linearized versions of these theories produce the same results in the hydrodynamic regime, it is possible to derive information about both types of theories. How the two-fluid hydrodynamic equations are modified by the presence of external fields is discovered. Once the hydrodynamic equations in the presence of the fields described above are known, the hydrodynamic limit of several microscopic correlation functions are determined. Further information about the viscosities of He II is derived in terms of the correlation functions. Finally, the hydrodynamic properties of the order-parameter magnitude are analyzed. A conservation law for it is derived that has the correct high- and low-frequency form, and a single relaxation-time model of it for all frequencies is constructed. (TSS) (Diss. Abstr. Int., B)

46797 ENERGY TRANSFER FROM A PULSED THERMAL SOURCE TO He II BELOW 0.3 K. Pfeifer, Charles Dean. St. Louis; Washington Univ. (1971). 170p. University Microfilms Order No. 72-9363.

Thesis.

Measurements are presented of the angular distribution of the energy flux generated by each of two small (~1 mm^2) pulsed heaters with different surface structures. The heaters are immersed in a large (~100 cm^3) volume of He II at a temperature near 230 mK. Heater pulse widths are varied from 50 to 1000 μs and heater power densities (W_H) from 100 to 6 w/cm^2. The amplitude of the radiated energy flux is monitored by six small carbon detectors oriented normal to the flux. They are located at distances (d) of 1 and 2 cm from the heaters and at angles (ϕ) varying from 7 to 89° with respect to the heater normals. For small W_H, the flux travels at 238 ± 10 m/s with no spatial attenuation or dispersion. At the critical heater flux density W_{SE} = 0.7 w/cm^2 for one heater and W_{SE} = 1.5 w/cm^2 for the other the radiated flux develops a slower component (second edge) traveling at the velocity, v_{SE} = 130 ± 40 m/s. At lower heater power densities the angular distribution of flux amplitudes is characteristic of the diffuse radiation of a noninteracting flux of phonons from the heater surface. When W_H exceeds 0.5 w/cm^2, the angular distribution of flux amplitudes is altered, indicating appreciable interactions among the excitations in the radiated flux near the heater surface. A semiempirical model for the growth of a helium black-body source from the heater surface is described that accounts for the angular distribution of flux amplitudes in the heater power density range $0.5 \leq W_H \leq 1.2$ w/cm^2. The second edge flux component is identified as the roton flux emitted from a helium black-body source at a temperature, $T_s > 0.6$ K. A second-sound pulse model is proposed that predicts qualitatively the angular distribution of the second edge flux amplitudes as well as the difference in the critical values W_{SE} for the two heaters. A spectral analysis of the energy flux is attempted to determine the extent to which the helium source is in thermal equilibrium at different values of W_H. (Diss. Abstr. Int., B)

46798 SURFACE-BOUND ELECTRONS ON LIQUID HELIUM: A NEGATIVE RESULT. Ostermeier, R. M.; Schwarz, K. W. (Univ. of Chicago). Phys. Rev. Lett.; 29: No. 1, 25-8(3 Jul 1972).

An experiment is described which was designed to measure both the lifetime and the mobility of image-potential-bound electrons on liquid helium. No evidence for bound states with a lifetime greater than a few microseconds was observed, in disagreement with the results of two different experiments recently presented by other authors. (auth)

46799 ABSENCE OF A QUADRATIC TERM IN THE ^{4}He EXCITATION SPECTRUM. Roach, Pat R.; Abraham, B. M.; Ketterson, J. B.; Kuchnir, M. (Argonne National Lab., Ill.). Phys. Rev. Lett.; 29: No. 1, 32-4(3 Jul 1972).

By directly measuring the difference in velocity of 30 and 90 MHz sound waves in liquid ^{4}He below 100 mK, it was determined that the elementary excitation spectrum cannot be described by an expression $\epsilon(k) = c\hbar k(1 + \alpha_1 k + \alpha_2 k^2 + \ldots)$ which has a value for α_1 that is greater than 0.01 Å. (auth)

46800 QUANTIZED VORTEX RING DYNAMICS AND THE VORTEX CORE RADIUS IN He II. Steingart, M.; Glaberson, W. I. (Rutgers–The State Univ., New Brunswick, N. J.). J. Low Temp. Phys.; 8: No. 1-2, 61-77(Jul 1972).

Using a newly developed time-of-flight technique, the temperature dependence of the vortex core radius in the range $0.35\ \text{K} \leq T \leq 0.60$ was determined by means of precise measurements of vortex ring dynamics. This work was extended to a measurement of the pressure dependence of the vortex core radius. The results are in agreement with the earlier work of Rayfield and Reif at T = 0.28 K and zero pressure and with a model of the vortex core proposed by Glaberson, Strayer, and Donnelly. The precision of the measurements enabled us to observe differences in the dynamics of oppositely charged vortex rings in the same electric field configurations. It was possible to quantitively account for these differences in a simple way by incorporating the frictional drag associated with the ion bound on the vortex core into the equations of motion. The results suggest that the negative ion shape is not greatly distorted by its presence on the vortex core, nor is the negative ion strongly shielded by the vortex velocity field. (auth)

46801 PERSISTENT CURRENT STATES IN ROTATING SUPERFLUID HELIUM. Kojima, H.; Veith, W.; Guyon, E.; Rudnick, I. (Univ. of California, Los Angeles). J. Low Temp. Phys.; 8: No. 3-4, 187-93(Aug 1972).

Persistent current states in superfluid helium contained in a rotating superleak are studied for various velocities and initial conditions. The change in the superfluid-component velocity as the normal-component velocity changes is interpreted in terms of a circulation-free potential flow and the entrance of vortices. The appearance of vortices of opposite sign to that of pre-existing ones in the superleak is discussed, and this is related to the history-dependent nature of persistent currents. An analogy between a superfluid helium system and a highly irreversible Type-II superconductor is made. (auth)

46802 SPIN-WAVE PHENOMENA IN LIQUID ^{3}He SYSTEMS. Corruccini, L. R.; Osheroff, D. D.; Lee, D. M.; Richardson, R. C. (Cornell Univ., Ithaca, N. Y.). J. Low Temp. Phys.; 8: No. 3-4, 229-54(Aug 1972).

The magnetic effects predicted by Leggett and Rice for Fermi liquids in the collisionless regime were verified. Spin-echo measurements are reported that demonstrate the existence of spin waves and undamped spin currents in liquid ^{3}He and dilute ^{3}He–^{4}He solutions. The experimental results are compared with the

theoretical expressions of Leggett and Rice, and values of the Fermi liquid interaction parameter $\lambda = [1/(1 + F_0^s)] - \{1/[1 + F_1^s/3)]\}$ are derived for liquid ^{3}He at P = 0 and 27 atm and a 6.4% ^{3}He–^{4}He solution. In addition, some techniques for direct observation of individual spin-wave modes are explored and the results reported. (auth)

46803 MICROSCOPIC THEORY OF IMPURITIES IN LIQUID HELIUM. II. Bowley, R. M. (Univ. of Nottingham, Eng.). J. Low Temp. Phys.; 8: No. 3-4, 261-75(Aug 1972).

A microscopic theory of impurities in liquid helium is developed from the theory of Sunakawa and coworkers. A canonical transformation is used to renormalize the phonons. The theory is applied to ^{3}He impurities, to positive ions, to the interaction between ^{3}He impurities, and to the interaction between a ^{3}He quasi particle and a positive ion. It is found that these interactions are zero in the long-wavelength limit, if the phonons are not renormalized. The coupling between the ^{3}He and the phonons due to the change in the binding energy of the ^{3}He with density variations is also considered. (auth)

46804 HIGH-RESOLUTION HEAT-CAPACITY STUDY OF ^{4}He ADSORBED ON BARE COPPER. Princehouse, D. W. (Univ. of Washington, Seattle). J. Low Temp. Phys.; 8: No. 3-4, 287-303(Aug 1972).

Detailed heat-capacity measurements were made over the range x = 0.03 to 1.15 monolayers and the temperature range T = 1 to 10 K. A small, on-line computer acquired and reduced the data in a very reproducible manner. Vapor–pressure measurements indicate that the substrate is strongly heterogeneous. The heat capacity, while qualitatively similar to previous data on Ar-plated copper, is best explained by a model based on extreme surface heterogeneity. (auth)

Superconductivity

Refer also to abstracts: 46021, 46031, 47269, and 47299.

46805 (BNL-16913) EFFECT OF SURFACE CONDITIONS ON SOME SUPERCONDUCTING PROPERTIES OF NIOBIUM. Strongin, M.; Farrell, H. H.; Varmazis, C.; Halama, H. J.; Kammerer, O. F.; Varma, M. N. (Brookhaven National Lab., Upton, N. Y.); Dickey, J. M. (Queens Coll., New York). 1971. 6p. (CONF-720513-8). Dep. NTIS.

From Applied superconductivity meeting; Annapolis, MD. (1 May 1972).

Measurements of gaseous impurities on the niobium surface are discussed which indicate higher oxygen levels than the bulk concentrations. Superconducting penetration depth measurements with various bulk oxygen concentrations are discussed, and they also indicate higher amounts of oxygen in the surface regime. Finally, the properties of thin films of Nb_3Sn grown on niobium, which can be used as a high T_c protective layer for the delicate niobium surface, are discussed. (M.H.R.)

46806 SINUSOIDAL CURRENT-PHASE RELATION FOR SUPERCONDUCTING THIN-FILM MICROBRIDGES. Gregers-Hansen, P. E.; Levinsen, M. T.; Pedersen, G. Fog (Univ. of Copenhagen). J. Low Temp. Phys.; 7: No. 1-2, 99-117(Apr 1972).

Superconducting systems separated by a very short weak link are treated using the one-dimensional Ginzburg–Landau theory. It is shown that, in the limit of extremely narrow and/or dirty links, $I \sim \sin \Delta\phi$. In the dirty limit the well-known expression for the Josephson tunnel current is obtained. However, the normal tunnel resistance is replaced by the resistance of the link in the normal state. The theoretical results are compared with our experimental investigations on thin-film microbridges of the Dayem type. Deviations from a sinusoidal current-phase relation are discussed in connection with microwave-induced subharmonic steps sometimes observed in the current–voltage characteristics. (auth)

46807 MAGNETIC PROPERTIES OF A SUPERCONDUCTOR WITH HEXAGONAL SYMMETRY. Takanaka, Kenji; Ebisawa, Hiromichi (Tohoku Univ., Sendai). Progr. Theor. Phys. (Kyoto); 47: No. 5, 1781-3(May 1972).

The anisotropic behavior of H_{c2}, K_2, and the distortion of the lattice structure of flux lines of technetium are discussed. The discussion is restricted to the isotropic BCS model Hamiltonian for the pairing interaction, in order to elucidate only the effects of the anisotropy of the velocity on the Fermi surface. (M.H.R.)

46808 THERMODYNAMICAL PROPERTIES OF A JOSEPHSON JUNCTION WITH A NORMAL-METAL BARRIER. Ishii, Chikara (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 47: No. 5, 1464-81(May 1972).

Thermodynamical properties are investigated for the current-carrying metastable states of a model of Josephson junction with a normal-metal barrier. The one-particle density of states and the thermodynamic potential are derived, including the effects of multiple particle–hole reflection of the electrons inside the barrier. The canonical relation between the phase-coupling energy and the barrier supercurrent is confirmed and expressed in a general form in terms of the phase-dependent density of states. (auth)

46809 LOCALIZED MAGNETIC STATES IN SUPERCONDUCTOR. Machida, Kazushige; Inoue, Chuya; Shibata, Fumiaki (Tokyo Univ. of Education). Progr. Theor. Phys. (Kyoto); 47: No. 5, 1482-90(May 1972).

The effect of a localized magnetic moment on superconductivity is investigated in the s–d exchange model with the generalized Hartree–Fock approximation. A bound state is shown to exist within the energy gap of a superconductor when the coupling is antiferromagnetic and the coupling constant J is greater than the pairing interaction g. When J is much greater than g, the system is shown to have the singlet ground state with the doublet excited state; in other cases, there is no bound state in the energy gap. Depression of superconducting temperature due to magnetic impurities is also calculated by using the t-matrix obtained in this approximation. The result obtained is rather different from those of other theories. (auth)

46810 STUDY OF LOSSES IN AN ASSEMBLY OF SUPERCONDUCTING FILAMENTS TRANSPOSED IN A CONDUCTING MATRIX AND SUBJECTED TO A PULSED MAGNETIC FIELD. Hlasnik, I.; Pouillange, J.-P. (CEN de Saclay, Gif-sur-Yvette, France). Rev. Gen. Elec.; 81: No. 2, 119-28(Feb 1972). (In French).

A quantitative study was made of the losses that can occur in a superconductor formed from an assembly of noninsulated superconducting filaments transposed in a normal-metal matrix when exposed to a transverse magnetic field. Expressions for the electric field demonstrate the existence of a critical length, l_c in a direction normal to the magnetic field and the thickness of the assembly, for which the current circulating between the superconducting plates is equal to their individual critical currents. It is demonstrated that for $l \leq 0.2l_c$ a negligible increase in losses in the coil results from the circulating currents. These results are extrapolated to deal with the real case of filament conductors. (France)

46811 TUNNELING GENERATION, RELAXATION, AND TUNNELING DETECTION OF HOLE-ELECTRON IMBALANCE IN SUPERCONDUCTORS. Tinkham, M. (Cambridge Univ., Eng.). Phys. Rev., B; 6: No. 5, 1747-56(1 Sep 1972).

The theory of electron tunneling is extended to treat the generation and detection of an imbalance Q between electronlike and holelike quasiparticle populations in superconductors. The equilibration of injected high-energy quasiparticles owing to inelastic phonon processes is discussed, and it is shown that in tin, Q relaxes in $\tau_Q \approx [\Delta(0)/\Delta(T)](2 \times 10^{-10})$ sec. It is also shown that even a small (~1%) anisotropy of the gap can lead to significant Q relaxation by elastic scattering processes. This discussion extends the previous brief interpretation of the pair-quasiparticle potential difference measured by Clarke. (auth)

46812 NUMERICAL CONSTANTS FOR ISOLATED VORTICES IN SUPERCONDUCTORS. Hu, Chia-ren (Univ. of Southern California, Los Angeles). Phys. Rev., B; 6: No. 5, 1756-60(1 Sep 1972).

For isolated vortex lines in high-κ, type-II superconductors, Abrikosov derived the expressions $B(0) = \kappa^{-2}(\ln\kappa + C_0)H_{c2}$ and $H_{c1} = \frac{1}{2}\kappa^{-2}(\ln\kappa + C_1)H_{c2}$, but the numerical values he provided for the constants C_0 and C_1 were previously found to violate an identity $C_1 - C_0 - \frac{1}{2} = C_\gamma > 0$. The constants are reevaluated, giving $C_0 = -0.282$, $C_1 = 0.497$, $C_\gamma = 0.279$. Furthermore, for superconductors containing a high concentration of magnetic impurities, it was previously shown that the electric field generated at the center of an isolated vortex in flux-flow situations is proportional to H_{c2} and the flux-flow velocity v. The proportionality constant C_E in the high-κ limit is numerically evaluated here to be 0.951, which, together with the value for C_γ, determines the flux-flow resistivity $\rho_f = 0.381\,\rho_n\langle B\rangle/H_{c2}$ in the low-applied-field limit when vortices are very far apart. (auth)

46813 THERMODYNAMIC PROPERTIES OF SMALL SUPERCONDUCTING PARTICLES. Muehlschlegel, B. (Univ., Cologne); Scalapino, D. J.; Denton, R. Phys. Rev., B; 6: No. 5, 1767-77 (1 Sep 1972).

In bulk superconducting systems the large intrinsic range of the pair coherence length implies an extremely narrow critical region. However, as is well known, the size of the critical region

becomes larger as the dimensions of the system decrease below the coherence length. An interesting limiting case corresponds to particles with all dimensions less than a coherence length which form essentially zero-dimensional systems. Here, the thermodynamic properties of small superconducting particles are calculated using a static approximation. Within this approximation, both the order parameter and the quasiparticle contribution are explicitly studied. (auth)

46814 DYNAMIC STRUCTURE OF VORTICES IN SUPERCONDUCTORS. III. GRAPHS FOR B ≈ H_{c2}. Thompson, R. S.; Hu, C.-R.; Smith, T. I. (Univ. of Southern California, Los Angeles). Phys. Rev., B; 6: No. 5, 2044-7(1 Sep 1972).

Graphs are presented illustrating the backflow generated by vortices moving in a superconductor as driven by a transport current. (auth)

46815 STUDY OF FLUX-FLOW NOISE IN TYPE-II SUPERCONDUCTORS. Shen, Shu-wei. Minneapolis; Univ. of Minnesota (1972). 95p. University Microfilms Order No. 72-20,148.

Thesis.

Flux-flow noise in type-II superconductors is investigated theoretically and experimentally. The observed noise turns out to be shot noise as expected from the assumption that the flux-flow voltage is generated by independently drifting flux bundles. Bundle sizes as large as 10^2 to 10^5 are found in vanadium foils, dependent on the biased condition. The experiment shows qualitative agreement with the theory. (Diss. Abstr. Int., B)

46816 ULTRASONIC ATTENUATION IN SUPERCONDUCTING INDIUM AND INDIUM–TIN ALLOYS. Binnie, David Earl. University Park, Pa.; Pennsylvania State Univ. (1971). 99p. University Microfilms Order No. 72-19,274.

Thesis.

The ultrasonic attenuation coefficients in the normal and superconducting states were measured as a function of temperature and orientation in single-crystal indium and three single-crystal indium–tin alloys with 0.01, 0.03, and 0.1 at. % tin. The measurements were made at temperatures between 1.0 and 4.2°K for ultrasonic waves propagating along the [001], [100], and [110] directions in the indium face-centered tetragonal lattice. The superconducting energy gap for each orientation and alloy was calculated from the ultrasonic data. (TSS) (Diss. Abstr. Int., B)

46817 RESISTIVE TRANSITION OF A SUPERCONDUCTOR. Thomas, Gordon Albert. Rochester, N. Y.; Univ. of Rochester (1972). 173p. University Microfilms Order No. 72-18,841.

Thesis.

Experiments testing the limits of applicability and the systematic breakdown of the mean field theory of superconductivity are presented. The electrical resistance is used as a probe of the theory in a study dealing with four interrelated aspects of the general problem. First, the linearized, time-dependent Ginzburg–Landau (GL) theory is investigated through experiments on the fluctuation conductivity of Al thin films in large electric fields above the transition temperature T_c. Second, one-dimensional microstrips are studied, and it is found that, although the simple linearized theory breaks down close to T_c, the theory can be extended into the region near T_c by the self-consistent inclusion of the fourth-order term in the GL free energy. The existence of a characteristic current for nonlinear phase slippage and a fluctuation resistance in the zero current limit below T_c in one-dimensional microstrips are demonstrated in experiments. The inadequacy of the simple mean field treatment of the fluctuation conductivity in clean samples above T_c is elucidated in the final section, where three studies of the effects of ephemeral Cooper pairs on the normal electrons are presented: two-dimensional $Sn_{.98}In_{.02}$ films in parallel magnetic fields, one-dimensional Al microstrips in parallel magnetic fields, and two-dimensional Al films with the addition of magnetic impurities. In all cases a quenching of the normal electron paraconductivity was observed as predicted by the theory. Experimental evidence is presented in this dissertation that the resistive transition of small superconducting specimens is strongly modified by the presence of thermodynamic fluctuations. These studies have yielded new information about the nature of phase transformations in solids and the time-dependent theory of superconductivity. (TSS) (Diss. Abstr. Int., B)

46818 ULTRASONIC ATTENUATION IN PURE NIOBIUM AT LOW TEMPERATURES. Alexander, Edward Michael. College Park, Md.; Univ. of Maryland (1972). 130p. University Microfilms Order No. 72-18,940.

Thesis.

Ultrasonic attenuation measurements were made on very pure niobium (RR ~ 5000) with ql values up to 11 at T_c. These measurements were made using a pulse-transmission method at frequencies up to 270 MHz and thin-sample handling techniques. The high value of ql was determined by fitting the data to a normal-state electronic-attenuation model and independently using magneto-acoustic criteria. Even though ql was much greater than 1, no rapid fall in the attenuation ratio was observed below T_c. This is the first such observation in the literature. Further, a low-temperature maximum in the normal-state attenuation as a function of temperature was observed. This phenomenon has thus far been reported for only one other metal, rhenium, and not previously from niobium. The relation of the maximum to the absence of rapid fall is also discussed. The data are compared with the data of all other groups who have measured shear wave attenuation in niobium. It is noted that for $ql \ll 1$ the attenuation ratio vs. temperature data follows BCS predictions, but that as sample purity increases there is increasing deviation from BCS. For $ql \sim 1$ the deviation from BCS predictions appears to be maximized. As frequency is increased in a high-purity specimen, the deviation from BCS becomes smaller, suggesting a return to the BCS prediction as ql is increased from $ql \sim 1$ to $ql \gg 1$. The deviations from BCS theory are examined in relation to recent models which will account for phonon scattering and interband effects. For the first time in niobium, magneto-acoustic oscillations (at least four) in the high-purity sample were also observed. From these oscillations it was possible to measure calipers of the niobium Fermi surface for directions in the (100) plane. These calipers are in good agreement with the theoretically predicted calipers for the so-called distorted ellipsoids of the niobium Fermi surface. (Diss. Abstr. Int., B)

46819 FLUX FLOW IN NONIDEAL TYPE-II SUPERCONDUCTORS. Kusayanagi, Eiichirou; Kawashima, Teruko; Yamafuji, Kaoru (Kyushu Univ., Fukuoka). J. Phys. Soc. Jap.; 33: No. 2, 551-60(Aug 1972).

The resistive behavior of the mixed state is studied theoretically in nonideal Type-II superconductors containing many defects. The fundamental equations are the time-dependent Ginzburg–Landau equations generalized from the conventional ones so as to describe elastic interactions of flux lines with defects. The solutions are obtained for the case of weak and localized defects by perturbation calculations in the vicinity of the upper critical field. It is shown that the flux-line lattice in nonideal samples can carry a finite amount of nondissipative transport current, which leads to the appearance of the depinning current term in the relation of the induced electric field to the transport current. A detailed expression of the critical current density is derived for a simple type of defect. An expression of the flow conductivity is shown to be also modified by the presence of defects. (auth)

46820 INELASTIC NEUTRON SCATTERING FROM VORTEX LATTICE IN TYPE-II SUPERCONDUCTORS. II. THE LONDON MODEL. Maki, Kazumi (Nuclear Research Center, Juelich, Ger.). J. Low Temp. Phys.; 8: No. 1-2, 47-59(Jul 1972).

The inelastic neutron scattering from the vortex lattice in type-II superconductors is considered. Use is made of the London model to describe the vibration of the vortex lattice. It is found that the differential cross section has sharp peaks besides the Bragg peaks when the transferred momentum q approaches the reciprocal lattice vector G. These peaks are due to excitation of the vibrational modes and diverge as $|q - G|^{-2}$. The Debye–Waller factor is also calculated, and is extremely small.

46821 TIME-DEPENDENT SUPERCONDUCTIVITY AND QUANTUM DISSIPATION. Rieger, T. J. (Univ. of California, Santa Barbara); Scalapino, D. J.; Mercereau, J. E. Phys. Rev., B; 6: No. 5, 1734-43(1 Sep 1972).

A time-dependent Ginzburg–Landau theory is used to calculate the time-varying currents and potentials in a one-dimensional superconductor undergoing quasi-continuous phase slip. To account for the irreversible nature of this process, the concept of superconducting dissipation is introduced. This analysis is consistent with many observations on weak links and provides an adequate model for at least their low-frequency behavior. (auth)

46822 PROBING MANY-BODY EFFECTS WITH SUPERCONDUCTIVITY. Chaikin, Paul Michael. Philadelphia; Univ. of Pennsylvania (1971). 251p. University Microfilms Order No. 72-17,336.

Thesis.

The principle forming the basis of this thesis is that superconductivity is the most (maybe the only) well-understood many-body problem in solids. The point emphasized is that other single- and many-body interactions can be probed with superconductivity and a great deal of information gained. To illustrate the usefulness of superconductivity in studying many-body effects, experiments dealing with magnetic impurities and the Kondo effect

were carried out. Two sets of experiments were undertaken: one involved the critical-field behavior of superconductors containing magnetic impurities and another involved tunneling into proximity-effect sandwiches with magnetic impurities in the normal-film side. Using multiple pairbreaking theory, the H_{c_2} data for pure La and for La–Ce and La–Gd alloys were analyzed. The tunneling experiments entail inducing a normal metal film (which contains magnetic impurities) superconducting by the proximity effect. This allows study of the density of states characteristic on the normal-metal side. The systems studied were AuFe/Pb and PdCo/Pb. (TSS) (Diss. Abstr. Int., B)

46823 RESISTIVITY OF THE INTERMEDIATE STATE OF TYPE-I SUPERCONDUCTORS. Lowell, J.; Parkinson, S.; Rose-Innes, A. C. (Univ. of Manchester, Eng.). J. Low Temp. Phys.; 8: No. 3-4, 277-85(Aug 1972).

The interaction between transport current and flux spots in the intermediate state of a superconductor is investigated. It is shown that the force on the flux spots depends on factors such as current lead configuration, and it is therefore not possible to define a unique flow resistivity for type-I superconductors. The conclusions are supported by experimental evidence. (auth)

46824 EFFECT OF STRAIN ON ULTRASONIC ATTENUATION IN SUPERCONDUCTORS. Das, H. L.; Chaudhuri, K. D. (Univ. of Delhi). Physica; 59: No. 4, 693-6(15 Jun 1972).

Ultrasonic-attenuation measurements in single crystals of 99.9999% pure tin were taken both in the superconducting and in the normal-conducting states with the help of the standard double-ended pulse-echo technique. Strain in the specimen has a pronounced effect on the attenuation in the superconducting state while attenuation in the normal conducting state remains uninfluenced by the amount of strain in the specimen. Normal conducting attenuations are also seen to be independent of amplitude of the ultrasonic pulses. For sufficiently strained samples, attenuation in the superconducting state becomes identical with that in the normal-conducting state. (auth)

46825 KINETIC EQUATION FOR SUPERCONDUCTING ALLOYS LOCATED IN WEAK STATIC FIELDS. Melik-Barkhudarov, T. K. (Inst. of Physical Research, Erevan). Dokl. Akad. Nauk Arm. SSR; 53: No. 1, 21-5(1971). (In Russian).

A simple case of a superconducting alloy positioned in a weak static field is mathematically developed. Certain matrix elements are encountered, which are assumed to be significantly different from zero in a narrow band of energy close to the Fermi surface of the order of the critical temperature. (K.S.W.)

46826 LOCAL MAGNETIC FIELD DISTRIBUTIONS IN SUPERCONDUCTING NIOBIUM AT 4.2 K BY NEUTRON DIFFRACTION. Schelten, J.; Ullmaier, H.; Lippmann, G. (Kernforschungsanlage, Juelich, Ger.). Z. Phys.; 253: No. 3, 219-31(1972).

Neutron-diffraction experiments on flux line lattices in superconducting Nb are reported. From the integral reflectivities of the (10), (11), (20), (21), and (31) reflections the absolute values of the form factors were obtained as a function of the flux density. Considering certain properties of the flux line lattice it is also possible to determine the phases of the form factors. From this the local field distribution in the mixed state could be calculated by Fourier transformation. The dependences of the resulting maximum, minimum, and saddle-point fields on the flux density and on the impurity parameter are discussed and compared with theory. (auth)

46827 TIME-DEPENDENT PHENOMENA IN WEAKLY-COUPLED SUPERCONDUCTORS. Leplae, L.; Mancini, F.; Umezawa, H. (Univ. of Wisconsin, Milwaukee). Nuovo Cim.; 10B: No. 1, 267-82(11 Jul 1972).

Two superconducting systems joined by a weak link present a great variety of phenomena which are not totally explained by the Josephson formulation. A general theory is given of the phenomena observed in these systems when time-dependent effects are taken into account. The formulation, presented as an application of the boson method in superconductivity, is derived from first principles in the framework of a microscopic theory. The results show the appearance of harmonic and subharmonic steps in the I–V characteristic of the system; the presence or not of subharmonic steps is essentially determined by the geometry of the system. The existence of subharmonic terms in ac effects is shown to be strongly related to the diffraction pattern presented by the I_c–H curves in dc experiments performed on the same sample. A comparison of the usual theory and the present formulation is discussed. (auth)

46828 IDENTIFICATION OF THE SUPERCONDUCTING PHASES IN THE MOLYBDENUM–PLATINUM SYSTEM. Fluekiger, R.; Paoli, A.; Roggen, R.; Yvon, K.; Muller, J. (Univ., Geneva). Solid State Commun.; 11: No. 1, 61-3(1 Jul 1972).

Structural-phase analysis was combined with an extensive study of the superconducting transitions, as observed magnetically and calorimetrically. The results show that the highest critical temperatures occurring in this system have been erroneously ascribed to the A-15-type structure. (auth)

46829 CRITICAL CURRENTS IN Nb_3Al. Martin, P. J.; Campbell, A. M.; Evetts, J. E. (Cambridge Univ., Eng.). Solid State Commun.; 11: No. 1, 123-5(1 Jul 1972).

Alternating current measurements on Nb_3Al showed that large amounts of the sample are driven normal at relatively low fields. Small variations of T_c are associated with very large variations of H_{C_2}, caused, most probably, by varying degrees of disorder. These regions of low H_{C_2} material may explain the low critical current densities measured in Nb_3Al and other A15 superconductors. (auth)

46830 SURFACE EXCITATIONS OF TYPE-I SUPERCONDUCTORS IN A STATIC MAGNETIC FIELD. Rogani, A.; Tabet, E. (Istituto Superiore di Sanita, Rome). Solid State Commun.; 11: No. 1, 127-30(1 Jul 1972).

Surface excitations of type-I superconductors in a static magnetic field are studied assuming diffuse scattering at the superconductor surface. The energy spectrum and the density of states for these excitations are obtained in the self-consistent field approach. Some remarks are made about the relevance of the surface states for the microwave impedance evaluation. (auth)

46831 DISCONTINUOUS FLUX FLOW IN SUPERCONDUCTING $NbSe_2$. Frindt, R. F.; Huntley, D. J.; Kopp, J. (Simon Fraser Univ., Burnaby, British Columbia). Solid State Commun.; 11: No. 1, 135-7(1 Jul 1972).

The flux flow resistance region was observed to end by a series of discontinuous steps to zero as the applied magnetic field or specimen current is increased. This supports Pippard's model of the flux line lattice deforming to match the pinning centres. A new interpretation of the peak effect in the critical current curve is also given. (auth)

46832 ANOMALOUS CRITICAL FIELD CURVES OF THE KONDO SUPERCONDUCTOR $(La_{1-x}Ce_x)Al_2$. Riblet, G.; Winzer, K. (Univ., Cologne). Solid State Commun.; 11: No. 1, 175-7 (1 Jul 1972).

The critical field curves of $(La_{1-x}Ce_x)Al_2$ alloys were investigated and a maximum in $H_{c_2}(T)$ for finite temperatures between 0.4 and 0.6°K for Ce concentrations $x > 0.003$ was observed. The results are in rough agreement with the theory of additive pair-breaking as applied to a Kondo superconductor. (auth)

46833 MAGNETIC FIELD DISTRIBUTIONS IN TYPE II SUPERCONDUCTORS. Inhaber, H. (Univ. of Oklahoma, Norman). Solid State Commun.; 11: No. 1, 275-8(1 Jul 1972).

The internal induction distribution of Type-II superconductors is calculated using experimental data on a Nb ellipsoid of Cline et al., (J. Appl. Phys., 37: 1(1966)) and a theory of Inhaber (1972). Qualitative agreement is found between theory and experiment; however, the distortion of fluxoid lattice due to shape, possible inhomogeneities in the distribution of pinning centers, and lack of probe resolution may be factors in preventing quantitative agreement. (auth)

46834 MODEL OF THE JOSEPHSON EFFECT. Turski, L. A. (Univ., Warsaw). Nuovo Cim.; 10B: No. 1, 102-10(11 Jul 1972).

A simple quantum-mechanical model of two coupled Bose systems exhibiting phase coupling, i.e., the Josephson effect, is proposed. The model is constructed in the spirit of the Bogolyubov's approach to the many-boson problem. The coherent-state technique is used. (auth)

46835 VOLTAGES INDUCED IN SUPERCONDUCTORS IN THE ABSENCE OF TRANSPORT CURRENTS. Ohmer, Melvin C.; Joiner, W. C. H. (Univ. of Cincinnati). Phil. Mag.; 26: No. 1, 15-32(Jul 1972).

When a superconducting sample is subjected to superimposed dc and oscillatory magnetic fields, under certain circumstances, voltages are found to exist in the sample even though no external currents are supplied. A dc voltage component is produced which reverses sign with a reversal in polarity of the dc magnetic field. Except for this sign reversal, the dc voltage versus dc field trace is symmetric with respect to field reversals. Voltage components are also present which are harmonics of the oscillatory field. The effects are quite complex and depend on the values of the many

parameters in the experiment. The results are discussed in terms of the existence of asymmetric flux flow through the sample during each cycle of the oscillatory field. (auth)

46836 EFFECT OF DISLOCATION TANGLES ON SUPERCONDUCTING PROPERTIES. Dew-Hughes, D.; Witcomb, M. J. (Univ. of Lancaster, Eng.). Phil. Mag.; 26: No. 1, 73-96(Jul 1972).

The microstructure of deformed Mo-34 at.% Re alloys was correlated with normal-state resistivity and superconducting properties. A model based on the dislocation cell structure is able to account for the variation of normal-state resistivity, upper and lower critical fields, and magnetic hysteresis, in the superconducting state. The superconducting properties are shown to be dominated by the presence of high-resistivity cell walls. In particular, the movement of quantized flux vortices is hampered by an interaction with the interfaces of this cell structure. Calculated parameters are in reasonable agreement with observed values. (auth)

46837 THEORY OF ELECTRON TUNNELING IN NIS SYSTEMS WITH PARAMAGNETIC IMPURITIES. Cheishvili, O. D. (Inst. of Physics, Tbilisi, USSR). J. Low Temp. Phys.; 8: No. 3-4, 213-18(Aug 1972).

Current-voltage characteristics of NIS junctions were studied when there are paramagnetic impurities in a narrow layer of the superconductor close to the insulator. It is shown that paramagnetic impurities in such systems considerably change the current-voltage characteristic in the narrow range of the applied potential $eV \sim \Delta$ and $V \sim 0$. (auth)

46838 SUPERCONDUCTIVITY AND LOCALIZED SPIN FLUCTUATIONS IN CONCENTRATED ALUMINUM-3d-TRANSITION-METAL ALLOYS. Babic, E.; Ford, P. J.; Rizzuto, C.; Salamoni, E. (CNR, Genoa). J. Low Temp. Phys.; 8: No. 3-4, 219-28(Aug 1972).

Measurements are presented of the superconducting transition temperatures of concentrated alloys of aluminum containing Ti, V, Cr, Fe, and Co, prepared using an ultrarapid quenching technique. These results extend the concentration range of existing measurements by one or two orders of magnitude. The data were analyzed using the theories of Kaiser and of Rivier and MacLaughlin, and it was found that both theories can adequately describe the results for the initial slopes $(dT_c/dn_I)_0$ and concentration dependence of T_c. In particular, from the theory of Rivier and MacLaughlin, characteristic temperatures were found for these alloys that are in agreement with those obtained from measurements on other physical parameters. (auth)

46839 CRYOGENIC PROBLEMS OF FORCED COOLED SUPERCONDUCTING SYSTEMS. Keilin, V. E.; Klimenko, E. Yu. (Inst. of Atomic Energy, Moscow). Cryogenics; 12: No. 4, 12: No. 4, 292-6(Aug 1972).

Methods of producing cold compressed helium, various ways of refrigerant distribution, and ways of reducing cool-down time being applied to forced-cooled superconducting systems (FCSS) are discussed. The conditions obtained are for preventing normal-zone propagation from current leads inwards into the winding. The analysis shows that main cryogenic problems of FCSS can be solved relatively simply. (auth)

46840 PHASE SENSITIVE METHOD FOR DETECTING SUPERCONDUCTIVE TRANSITIONS IN THE MICROWAVE REGION. di Crescenzo, Enrico; Flamini, Mario; Indovina, Pietro L.; Onori, Sandro; Rosati, Alfredo. Ann. Ist. Super. Sanita; 7: 560-84(1971). (In Italian).

The measurement method described detects superconductive transitions as a function of the magnetic field applied by means of a phase-sensitive technique. A detailed description of the modulation parameters is given according to the criteria followed in EPR experiments. In the description of the experimental equipment, particular attention is given to the stabilization system of the microwave generator and to the detection method. Furthermore, the resonant cavity associated with the cryogenic system is fully explained. (auth)

Equipment and Devices

Refer also to abstract: 45679.

46841 INTRODUCERE IN FIZICA TEMPERATURILOR JOASE. (Introduction to Low Temperature Physics). Balla, D.; Deutsch, R. V. Bucharest; Editura Academiei Republicii Socialiste Romania (1970). 494p. Lei 31.

Proceeding from a study of the solution properties of the Schroedinger equation, problems related to the isoenergetic and Fermi surfaces are examined. The Brillouin zones and energy bands are introduced, conclusions arising from the dispersion equations are formulated, and theoretical methods used for the study of the isoenergetic and Fermi surfaces are presented. A concise description of the principles of phenomenological thermodynamics is given in a form corresponding to the presence of electric and magnetic fields. A systematic exposition of the statistical physics methods used is given. Practical methods used for realization of low temperatures are described. Temperature measurement methods are covered. Magnetic properties of substances at low temperatures are presented. The theory of specific heats of solids at low temperature is dealt with. Transport phenomena in solids at low temperature are covered. Liquid helium properties are described. Experimental and theoretical results referring to superconductivity are presented. (M.H.R.)

46842 METHOD AND MEANS FOR CHARGING OR DISCHARGING SUPERCONDUCTING WINDINGS. Bergmann, Winfried H. U. S. Patent 3,667,029. 30 May 1972. Filed 15 Apr 1970.

A winding of superconducting material is charged by electrically shorting the winding with a hard Type-II series superconducting material and cooling the winding and shorting material to a superconducting temperature. A magnetic flux is generated to penetrate the shorting material to establish therein fluxoids and a temperature gradient is established across the shorting material to cause motion of the fluxoids across the shorting material into the magnetic circuit of the winding to effect charging or discharging thereof. (Official Gazette)

46843 SUPERCONDUCTIVE MAGNETS. Donaldson, Gordon W.; Graham, Charles D. Jr.; Hart, Howard R. Jr. (to General Electric Co.). U. S. Patent 3,665,351. 23 May 1972. Filed 9 Jul 1970.

Superconductive tape-wound solenoids used for the production of high magnetic fields are susceptible to being driven into the normal resistance state by flux jumping occurring in the end coils. This is caused by the high concentration of magnetic flux components perpendicular to the planes of the tapes in these coils. The performance of such solenoids may be substantially improved by providing an alternative path for such flux components through a body having a relatively high saturation magnetization such as iron or mild steel closely adjacent the end coils but electrically isolated therefrom. (Official Gazette)

46844 TUBULAR NIOBIUM/COPPER CONDUCTORS FOR AC SUPERCONDUCTIVE POWER TRANSMISSION. Graeme-Barber, C. (Central Electricity Research Lab., Leatherhead, Eng.); Maddock, B. J.; Popley, R. A.; Smedley, P. N. Cryogenics; 12: No. 4, 317-8(Aug 1972).

Composite niobium/copper tubes with diameters of the order of those that would be required for superconducting cables (eg 63.5 and 100 m) were made with power ratings of a few GVA. Although the detailed electrical performance of these tubes has still to be determined, the results of measurements on small samples suggest that power losses will be acceptably low. Areas in which problems remain are outlined. (UK)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts: 47220–47224 and 47251.

46845 (BNL–16935) FOURIER TRANSFORM OF INELASTIC NEUTRON SCATTERED INTENSITY FOR SOLID ^{4}He. Gilbert, Ernest (Brookhaven National Lab., Upton, N. Y.). 1972. 47p. Dep. NTIS.

The inelastic scattering of neutrons was used to study the properties of solid ^{4}He. Fourier transforms were used to determine the probability density of the helium atoms. (J.W.R.)

46846 (JEN–221) GREEN FUNCTION IN THE SECONDARY MODEL OF THERMALIZATION. Guasp, Jose (Junta de Energia Nuclear, Madrid (Spain)). 1972. 170p. (In Spanish). Dep. NTIS (U. S. Sales Only).

The Green function of the thermalization problem is studied in the secondary model case through the spatial Fourier transform. A relation between singularities and eigenvalues allows the determination of the analyticity dominion. The eigenvalues spectrum has a purely discrete part, lying on an interval of the imaginary axis of the k complex plane (the Fourier parameter), and another part, purely continuous, lying in the remainder of the imaginary axis. A correspondence between discrete eigenvalues and "exponential modes" of the Green Function, extremal properties for the eigenvalues and some remarkable properties of the eigenfunctions are established. The numerical methods used, results about the possibility of disappearance of the fundamental eigenvalue when the absorption is increased, and the apparition of a "pseudo-fundamental" mode in the Green Function are discussed. (auth)

46847 TIME-DEPENDENT NEUTRON TRANSPORT EQUATION WITH DELAYED NEUTRONS. Yoo, Kun Joong; Pac, Pong Youl (Seoul National Univ.). J. Korean Nucl. Soc.; 4: No. 2, 102-8(Jun 1972).

The time-dependent neutron transport equation with delayed neutrons is analytically solved for the case of isotropic scattering with constant cross sections. The equations in the two divided time regions are obtained from the original equation by the asymptotic method. It is shown that the approximate solutions in each time region are uniformly valid in time to the order of the inverse magnitude of the velocity. (auth)

46848 FAST NEUTRON TIME-OF-FLIGHT SPECTROMETER WITH HIGH RESOLUTION. Cho, Mann (Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 4: No. 2, 116-31(Jun 1972).

A fast neutron time-of-flight spectrometer was constructed (with suitable choice of target thickness and proton bombarding energy in the ^{7}Li(p,n)^{7}Be nuclear reaction) for a continuous keV spectrum of neutrons at 0 degrees in 1-ns pulses from a Van de Graaff. A time-pick-up fast neutron detector with a 5-mm-thick, 92% enriched ^{10}B slab and four heavily shielded 4" × 3" NaI scintillation detectors was assembled. The energy resolution of this spectrometer is better than 0.3% at 50 keV, and the signal-to-background ratio is also improved. Total cross section measurements of several separated single isotopes were carried out with this spectrometer and analyzed by an R-matrix multi-level computer code. The spin values and resonance parameters of each individual resonance are given. (auth)

46849 NEW RESULTS IN THEORY OF PULSED THERMAL NEUTRONS. Protopopescu, V. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 24: No. 3, 347-67(1972). (In Rumanian).

Topics discussed include the analytical structure of the solution in the continuous sections case, an experimental situation, the analytical structure of the solution in the discontinuous sections case, and the analytical extension of the dispersion law. (J.N.R.)

46850 GREEN'S FUNCTION OF THE NEUTRON TRANSPORT EQUATION FOR A MOVING MEDIUM. Garusov, E. A.; Petrov, Yu. V. This paper was summarized in At. Energ. (USSR); 30: No. 5, 444-5(May 1971) as paper No. 485/5933. (In Russian).

Full copy of this paper is held by TIC.

The system of eigenfunctions of the stationary neutron transport equation is generalized to the case of nuclei of infinite mass that move with the same velocity u in a direction perpendicular to the plane of the source. It is assumed that the cross sections are independent of the energy and that the neutrons are scattered isotropically in the center of mass system. (auth)

46851 SOLUTION OF MULTI-DIMENSIONAL NEUTRON TRANSPORT EQUATION BY FINITE ELEMENT METHOD. Ukai, Seiji (Kyoto Univ.). J. Nucl. Sci. Technol. (Tokyo); 9: No. 6, 366-73(Jun 1972).

A scheme of treatment with the finite element Galerkin method is proposed for the approximation of solutions of multi-dimensional steady state neutron transport equations, and it is proved that the approximate solutions yielded by the treatment converge to the solutions of the transport equations under reasonable hypotheses. These approximate solutions are used also to show the existence of weak solutions of transport equations. Finally, based on the Galerkin method, the conditions for convergence are discussed for the multi-group approximation and for the method of spherical harmonics. (auth)

46852 PROTECTION FROM THE NEUTRON EMISSION OF ^{238}Pu DIOXIDE. Zharkov, V. A.; Chudotvorov, A. A.; Moiseenko, B. A. This paper was summarized in At. Energ. (USSR); 31: No. 1, 50-1(Jul 1971) as paper No. 505/6061. (In Russian).

The neutron spectrum, dose multiplicity of the attenuation afforded by water shielding, and cross section for neutron removal by iron were investigated for a specimen of $^{238}PuO_2$. The neutron yield was measured to be $(2.0 \pm 0.2) \times 10^4$ n/s-g of ^{238}Pu. Calculations were made to determine the specific contributions made by the neutrons from the (α,n) reaction with oxygen and by spontaneously generated neutrons to the total yield; the calculated spectrum agreed well with the experimental one. The flux-to-dose conversion coefficient was found to be $(3.70 \pm 0.25) \times 10^{-5}$ mrem/n/cm^2 for the specimen examined. The experimentally obtained curve for the dose multiplicity of the attenuation of neutron radiation from $^{238}PuO_2$ by water shielding in semi-infinite geometry was compared with the corresponding calculated curve. They differed somewhat; this difference was attributed to the barrier effect. The removal cross section was found to be 1.80 ± 0.07 b. It was established that the neutron removal cross section is independent of the thickness of the removing materials (iron) and the thickness of the water shielding, provided that this is between 30 and 45 cm. (4 figures) (R.W.R.)

46853 INTERFERENCE IN THE ULTRACOLD NEUTRON TRANSMISSION THROUGH THIN LAYERS. Steyerl, A. (Technische Univ., Munich). Z. Phys.; 252: No. 5, 371-82(1972).

At the time-of-flight spectrometer for ultracold neutrons (UCN) with energies below 10^{-4} eV at the FRM, Munich, the perpendicular neutron transmission through carbon and gold films of thickness 450 to 800 Å was measured as a function of neutron velocity in the range $11 \geqq v_z \geqq 3.7$ m/s. The transmission curves obtained show the expected interference patterns due to interference between the partial waves transmitted and reflected at the two surfaces. From these curves absolute values for the thickness and density could be obtained. From the UCN transmission through a 4.71-μm-thick copper foil a value $a_{coh} = 7.5 \pm 0.15$ F was derived for the nuclear scattering length of Cu. (5 figures) (auth)

46854 TWO-DIMENSIONAL TRANSPORT PROBLEMS IN A QUARTER SPACE. Lam, Siu Kee. Stanford, Calif.; Stanford Univ. (1971). 108p. University Microfilms Order No. 72-11,593.

Thesis.

Neutral particle transport phenomena in a quarter space are investigated by considering the one-speed integral transport equation. Both the homogeneous (Milne's problem) and inhomogeneous (constant-source problem) form of the transport equation are examined. For both problems, the method of attack is double Fourier transformation and use of the one-dimensional Wiener-Hopf technique. All contributions to the density asymptotically away from the corner are determined explicitly by considering two appropriate half-space problems and by extensive use of contour integration in two complex variables. The remaining contributions near the corner are obtained by iterating the transport equation. Numerical results are given for a particular symmetric Milne's problem and a particular constant-source problem. Diffusion theory results for these problems are given for comparison. Extension to the case of a quarter space surrounded by another medium with the same total cross section but different mean number of particles emitted per collision is also given. (Diss. Abstr. Int., B)

46855 SUBCRITICAL MULTIPLICATION OF ^{252}Cf NEUTRONS AND ITS APPLICATIONS. Hansen, L. E.; Wogman, N. A.; Perkins, R. W.; Clayton, E. D. (Battelle-Northwest, Richland, Wash.). Nucl. Technol.; 15: No. 3, 422-30(Sep 1972).

Calculations were performed which indicate that thermal flux

increases of a factor of 20 should be possible through the optimal use of fissile material regions surrounding ^{252}Cf sources. For demonstration purposes, a subcritical system was assembled and used for trace element determination in marine life, terrestrial biota, and mineral specimens. This multiplying assembly consisted of PuO_2 admixed with polystyrene and reflected with Plexiglas. Source neutrons were provided by a 200 microgram ^{252}Cf source. A neutron flux amplification of about fivefold was achieved at the ^{252}Cf source, while an amplification of some 40-fold was obtained 16 cm from the source where the majority of source exposures would be made. (auth)

46856 REMARK ON NEUTRON SLOWING DOWN. Dvorak, S.; Kropac, B. (Tesla, Roznov, Czech.). Czech. J. Phys.; 22: No. 6, 459-67(1972).

The density, $W_n(U)$, of the neutron lethargy probability distribution after the n^{th} collision with nuclei of a moderator was found by using the integral representation of the Dirac δ function. It was assumed that the collisions are elastic and lethargy increments in individual collisions are independent. This procedure leads to expression of $W_n(U)$ by an improper integral, which is in turn converted to a finite sum. In addition, the asymptotic behavior of $W_n(U)$ for a great number of collisions n was determined. (auth)

46857 DISAPPEARANCE OF NEUTRON DIFFUSION LENGTH OF BERYLLIUM AND GRAPHITE ACCORDING TO TEMPERATURE. Yamagishi, Tomejiro; Deguchi, Ichiro; Sekiya, Tamotsu (Osaka Univ.). J. Nucl. Sci. Technol. (Tokyo); 9: No. 6, 375-8(Jun 1972).

A modified synthetic scattering kernel was used to examine the temperature dependence of the neutron diffusion length in beryllium and graphite. The critical temperature for the disappearance of the diffusion length was determined for both cases. (J.W.R.)

46858 SLOW NEUTRON SPECTRA IN THE LIQUID AND SOLID METHANE. Inoue, Kazuhiko (Hokkaido Univ., Sapporo); Otomo, Norio; Utsuro, Masahiko; Fujita, Yoshiaki. J. Nucl. Sci. Technol. (Tokyo); 9: No. 6, 374-5(Jun 1972).

Neutron spectra in cold methane were measured at four temperatures from 13 to 112°K. A pulsed source and the time-of-flight technique were used. The results show that very cold solid methane should be an effective moderator for cold pulsed neutron sources. (J.W.R.)

46859 PARALLEL SHOOTING METHOD FOR BOUNDARY-VALUE PROBLEMS: APPLICATION TO THE NEUTRON TRANSPORT EQUATION. Canosa, Jose; Penafiel, H. R. (IBM Data Processing Division Scientific Center, Palo Alto, Calif.). IBM J. Res. Develop.; 16: No. 4, 354-64(Jul 1972).

A direct method is given for the solution of the spherical harmonics approximation to the Boltzmann equation for neutron transport in slab geometry. The roundoff instability of the problem is eliminated by performing linear transformations of the matrices involved, which ensure that the matrix columns are linearly independent. The novelty of the method lies in that only a minimum number of matrix transformations is performed, the precise number being determined dynamically, efficiently, and in a new way by the program itself in the course of the computation. (auth)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstract: 46887.

46860 (LYCEN-7186) FINAL STATE INTERACTION BETWEEN THE PROTON AND THE NEUTRON FROM THE $^1H(d,pn)^1H$, $^2H(d,pn)^2H$, $^3He(d,pn)^3He$, AND $^4He(d,pn)^4He$ REACTIONS. Ille, Bernard (Lyon Univ. (France). Institut de Physique Nucleaire). 1971. 55p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The following reactions were studied at 27.5 MeV: d(p,pn)p, d(d,pn)d* d(^{3}He,pn)^{3}He and d(^{4}He,pn)^{4}He. The experimental results were analyzed using the Watson–Migdal final interaction model and the Phillipps–Griffy–Biedenharn sequential model to establish the production of the d* singlet. Both models satisfactorily explain the final state interaction between the proton and the neutron in d + p, d + d, and d + ^{4}He reactions. ^{4}He* and ^{4}Li* resonances complicate the d + ^{3}He reaction. From the point of view of the deuteron singlet, these different reactions establish with certainty a peak in the final state interaction corresponding to the production of d* considered as a pseudo-particle with isospin T = 1. (France)

46861 $^2H(n,p)2n$ REACTION AT 50 MeV AND THE NEUTRON–NEUTRON SCATTERING LENGTH. Stricker, A. (Tokyo Univ.); Saji, Y.; Ishizaki, Y.; (and others). Nucl. Phys.; A190: No. 2, 284-92(1972).

The proton energy spectrum from the deuteron break-up induced by 50 MeV neutrons has been measured with a broad-range magnetic analyzer followed by a 200-proportional-counter array and a plastic scintillation counter at the mean proton angle of 3.8° in the lab system. The measured spectrum was compared with the theoretical one calculated as a function of the neutron-neutron scattering length a_{nn} on the basis of the impulse approximation. From this comparison, $a_{nn} = -21.7 \pm 1.2$ fm was extracted at the effective range of 2.60 fm. (auth)

46862 NON-RESONANT ATTRACTION BETWEEN NEUTRONS IN THE $\pi^- + {}^3He \rightarrow \pi^+ + 3n$ REACTION. Phillips, A. C. (Univ. of Manchester, Eng. Daresbury Nuclear Physics Lab., Eng.). Phys. Lett.; 33B: No. 4, 260-2(26 Oct 1970).

It is shown that the tendency for a low energy three-neutron system to be emitted in the $\pi^- + {}^3He \rightarrow \pi^+ + 3n$ reaction does not imply the existence of a three-neutron resonance. (auth)

46863 ELASTIC SCATTERING OF PROTONS BY DEUTERONS AT ENERGIES OF 14, 16, AND 17.6 MeV. Kiseleva, Z. P.; Skorodumov, B. G.; Radyuk, G. A.; Rasulov, E. N.; Talanin, Yu. N. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 4, 83-5(1971). (In Russian).

The angular distributions of protons scattered by deuterated polyethylene were measured from 20 to 150°. The 17.6-MeV protons were generated in a cyclotron; energy reduction to 16 or 14 MeV as desired was accomplished by aluminum foils. The results obtained may be used in phase analysis. (1 figure, 1 table) (K.S.W.)

46864 ANALYSIS OF NEUTRON–DEUTERON ELASTIC SCATTERING AT LOW ENERGY. Viennet, R. (Univ., Neuchatel, Switzerland). Nucl. Phys.; A189: No. 2, 424-38(1972). (In French).

The results of an effective-range analysis of elastic n–d scattering below the deuteron break-up threshold are given. Total spin and orbital angular momentum are supposed to be conserved, and J degeneracy is admitted. The S-, P-, and D-states only are taken into account. No confirmation of the pole of Van Oers and Seagrave in the effective-range function of the ^2S state was obtained. (9 figures, 4 tables) (auth)

46865 DEUTERON–DEUTERON SCATTERING IN THE CASE OF NONCONSERVATION OF CHANNEL SPIN. Pham Dinh Lien (Institut des Sciences Nucleaires, Grenoble, France). Nucl. Phys.; A189: No. 3, 665-72(1972).

Deuteron-deuteron elastic scattering is studied in case of non-conservation of the channel spin, that is, the possibility of transitions between singlet and quintet channel-spin states. The mixing parameter, which measures the coupling between two different orbital angular momenta, is also taken into account in the calculation of the transition-matrix amplitudes. Expressions are given for the cross section and the polarization in terms of the phase shifts. (auth)

46866 CHARGE-DEPENDENT EFFECTS IN THE PHOTODISINTEGRATION OF ^4He. Londergan, J. T. (Indiana Univ., Bloomington. Case Western Univ., Cleveland); Shakin, C. M. Phys. Rev. Lett.; 28: No. 26, 1729-32(26 Jun 1972).

$^4He(\gamma,p)^3H$ and $^4He(\gamma,n)^3He$ cross sections have been calculated for photon energies from the (γ,n) threshold to 34 MeV. Effects of Coulomb interactions, channel spin mixing, and mass differences have been taken into account using a coupled-channel continuum-shell-model calculation of $p-^3H$ and $n-^3He$ elastic and charge-exchange scattering. The ratio $\sigma(\gamma,p)/\sigma(\gamma,n)$ is predicted to be close to 1, except at energies very close to the (γ,n) threshold. (auth)

46867 MAGNETIC MOMENTS OF ^3He AND ^3H. Gerstenberger, R. V.; Nogami, Y. (McMaster Univ., Hamilton, Ont.). Phys. Rev. Lett.; 29: No. 4, 233-7(24 Jul 1972).

The electromagnetic structure of a nucleon in a nucleus is different from that of a free nucleon. This difference is examined for the two-pion part of the form factor by considering interactions with other nucleons in the course of pion emission and absorption, but without exchanging charge. For ^3He and ^3H, the isovector part of the magnetic moment increases by an amount which is comparable to the outstanding discrepancy between the experimental and theoretical values. (auth)

46868 EVIDENCE FOR AN ANOMALY IN THE EXCITATION FUNCTION OF THE REACTION $^3H(p,\gamma)^3He$. Chang, C. C.; Diener,

E. M.; Ventura, E. (Stanford Univ., Calif.). Phys. Rev. Lett.; 29: No. 5, 307-9(31 Jul 1972).

The excitation function for the capture reaction $^2H(p,\gamma)^3He$ was measured in the range E_p = 10 to 17.5 MeV. An anomaly was observed and is interpreted as a broad resonance in ^3He at an excitation energy of 14.5 ± 0.5 MeV with a width of about 2 MeV. (auth)

46869 EXPERIMENTAL INVESTIGATION OF THE REACTION (π^-,π^-p) ON ^6Li AND ^{12}C AT A MOMENTUM OF 1 GeV/c. Bayukov, Yu. D.; Vorob'ev, L. S.; Grigor'ev, E. A.; (and others) (Inst. of Theoretical and Experimental Physics, Moscow). pp 410-22 of Problems of Modern Nuclear Physics. /Kolybasov, V. M. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

From second symposium on the problems of nuclear physics; Novosibirsk, USSR (12 Jun 1970).

The reactions $\pi^- + {}^{12}C \rightarrow \pi^- + p + {}^{11}B$ and $\pi^- + {}^6Li \rightarrow \pi^- + p + {}^5He$ were investigated with a 1 GeV beam of π^--mesons from a 7 GeV proton synchrotron. A magnetic spectrometer with four spark chambers was employed in analyzing the momentum of the scattered π^--mesons. The reactions may be adequately described with a polar diagram; however, at large imparted momenta other diagrams provide a significant contribution. (K.S.W.)

46870 NEW RESULTS ON $(\pi^+,2p)$ REACTIONS IN LIGHT NUCLEI. Bressani, T.; Charpak, G.; Favier, J.; Meyerhof, W. E.; Zupanic, C. (CERN, Geneva). pp 444-56 of Problems of Modern Nuclear Physics. /Kolybasov, V. M. (ed.). Moscow; Izdatel'stvo Nauka (1971).

From second symposium on the problems of nuclear physics; Novosibirsk, USSR (12 Jun 1970).

Some results on $(\pi^+,2p)$ reactions on O, ^4He, ^6Li, ^{12}C, ^{14}N, and ^{16}O at 76 MeV are presented. The protons were detected in coincidence at a mean angle of 76° with respect to the incident pion beam. The excitation energy of the residual system was determined. Cross sections were derived assuming a peripheral mechanism. The results are compared with other data and with theory. (J.W.R.)

46871 STUDY OF $^2H + {}^3He$ ELASTIC SCATTERING AND THE REACTION $^2H(^3He,^4He)^1H$ BETWEEN 17.5 AND 44.1 MeV. King, Thomas Richard. Boulder, Colo.; Univ. of Colorado (1971). 198p. University Microfilms Order No. 72-17,276.

Thesis.

An investigation of $^2H + {}^3He$ elastic scattering and the reaction $^2H(^3He,^4He)^1H$ has been conducted at bombarding energies between 17.5 and 44.1 MeV to determine whether any states in ^5Li, with appreciable widths for decay into two-body final states, exist in the region of excitation from 23.4 to 34 MeV in ^5Li. An excitation function for $^2H + {}^3He$ elastic scattering was measured at three laboratory scattering angles, and for $^2H(^3He,^4He)^1H$ at four laboratory scattering angles. No evidence was found for virtual states of the nucleus ^5Li having appreciable two-body decay widths between 23.4 and 30.4 MeV excitation. Any such states have widths less than 200 keV between 23.4 and 25 MeV, less than 1.4 MeV between 25 and 30.4 MeV, less than 100 keV between 30.4 and 31 MeV, and less than 1 MeV between 31 and 34 MeV excitation in ^5Li. Complete angular distributions for $^2H + {}^3He$ elastic scattering and the reaction $^2H(^3He,^4He)^1H$ were taken at several bombarding energies between 18.5 and 44.1 MeV. A partial-wave decomposition of the elastic scattering angular distributions has been performed. No anomalous behavior is observed. The angular distributions were also fitted with a linear Legendre polynomial series. Finally, the angular distributions have been compared to the predictions of two simple direct-reaction theories: the Butler stripping theory and the diffraction theory. The fits to the Butler theory are satisfactory, and the fits to the diffraction theory are remarkably good. Absolute differential cross sections were measured to an accuracy of 3%. At bombarding energies below 21.6 MeV they supplement existing data of comparable accuracy. Between 34.8 and 40.5 MeV bombarding energy, existing data are sparse, and of only moderate (14%) accuracy. The present work extends the data in this region, and improves the absolute accuracy by a factor of five. The differential cross sections measured above 40 MeV in the present work are the only data in this energy region. (Diss. Abstr. Int., B)

46872 DIFFERENTIAL CROSS SECTIONS FOR SMALL ANGLE n-p SCATTERING AT 24 MeV. Masterson, Thomas G. Madison, Wis.; Univ. of Wisconsin (1972). 163p. University Microfilms Order No. 72-13,984.

Thesis.

The differential cross section for n-p elastic scattering was measured at 19.5° and 25.1° (lab) for an incident neutron energy of 24 MeV. The neutron source was the $T(d,n)^4He$ reaction at 0°. Both target and detector were liquid scintillators and neutrons were detected in each by the recoil protons produced. A time-of-flight coincidence requirement between target and detector pulses reduced background. A neutron-gamma pulse shape discrimination system eliminated gammas from the detecting scintillator. An on-line computer stored and analyzed the recoil proton pulse height spectra. Normalization of the scattering data to the 0° neutron flux yielded an absolute differential cross section. A change in the flight time requirement specified the accidental coincidence background. The insertion of a shadow bar between target and detector determined room scattered backgrounds. Corrections were made for finite target and detector thicknesses, finite solid angles, wall effects and multiple scattering. The total cross sections calculated by Hopkins and Breit were used to determine detector efficiencies at different energies and relativistic kinematics to convert angles and cross sections from the lab to the CM system. The cross section measured at a CM scattering angle of 39.3° is 31.20 ± 0.45 mb/sr. This value agrees with the cross section predicted by Hopkins and Breit which is 31.3 mb/sr using the LRL phase shifts or 31.0 mb/sr using the Yale phase shifts. The cross section measured at a CM scattering angle of 50.5° is 30.7 ± 0.6 mb/sr. This value also agrees with the cross section predicted by Hopkins and Breit which is 31.0 mg/sr using the LRL phase shifts or 30.7 mb/sr using the Yale phase shifts. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts: 46486, 46664, 46870, 46903, 46907, 46912, 46915, 46929, 47074, 47075, 47077, and 47083.

46873 (CEA-N-1522) NUCLEAR PHYSICS DEPARTMENT. Progress Report, October 1, 1970-October 15, 1971. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 358p. (In French). Dep. NTIS (U. S. Sales Only).

This progress report covers the whole set of experiments and technological studies undertaken at the Nuclear Physics Department during the past year. The experimental activity at the 600-MeV electron linear accelerator (ALS) is now well in progress with beams of electrons, photons (bremsstrahlung) and pions giving interesting and sometimes unexpected results. Activity continues at the cyclotron, particularly with the study of fourth-order deformations in heavy nuclei. The tandem Van de Graaff is mainly used for systematic research on many-nucleon-transfer reactions with heavy-ion beams. The first experiments of high-resolution spectroscopy at the Saturne Synchrotron (1-GeV protons) are expected for the beginning of 1972. Giant resonance experiments and fission studies carried out by a branch recently connected with the Nuclear Physics Department, the activity of which is centered around a 60-MeV electron linac (AL 60) and reactors (EL 3 and Triton), are presented in this report for the first time. (auth)

46874 (JUL-834-RG) ABSOLUTE MEASUREMENT OF THE $^9Be(n,2n)$ CROSS SECTION IN THE ENERGY REGION OF 2.37 TO 3.24 MeV. Bloser, Manfred (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung). Mar 1972. 101p. (In German). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Technische Hochschule, Aachen (West Germany).

Since the energy of DD neutrons is angle dependent, quasi-monoenergetic neutrons of 2.37, 2.53, 2.77, 2.99, 3.21, and 3.34 MeV of energy could be produced; their energy distribution was measured by a ^3He semiconductor spectrometer. The direct determination of the (n,2n) reaction probabilities by means of a 4π Gd liquid scintillator with a double-pulse technique for identification of (n,2n) neutrons was done absolutely by determining the efficiency of the Gd detector. The applied scattering block-method for the measurement of the neutron intensity was not primarily based on the knowledge of other cross sections. After taking into account the measured energy distribution of primary neutrons and multiple scattering processes in the Be target by a simple Monte Carlo process, the $^9Be(n,2n)$ cross sections are given, and possible reaction mechanisms are discussed. (17 figures, 6 tables) (auth)

46875 (KFK-EXT-10/72-1) MEAN EXCITATION ENERGIES OF THE DAUGHTER NUCLEI ON β^--DECAY. Keller, K. A.; Muenzel, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie). Feb 1972. 51p. (In German). Dep. NTIS (U. S. Sales Only).

For the prediction of unknown half-lives of β^--decay the knowledge of mean excitation energies of the daughter nuclei is of great importance. Therefore a compilation of mean excitation energies is given in tables and figures. The accuracy of the half-lives taking into account these mean excitation energies is discussed. (auth)

46876 (ORNL-TM-3859) REVIEW OF THE CROSS SECTIONS OF THE ISOTOPES ^{6}Li AND ^{7}Li AS TABULATED ON THE ENDF/B VERSION III FILES. Tobias, Melvin (Oak Ridge National Lab., Tenn.). Jul 1972. Contract W-7405-eng-26. 60p. Dep. NTIS.

The following report reviews the cross section information contained in the ENDF/B files concerning the isotopes ^{6}Li and ^{7}Li. The purpose of this study is to seek out those areas of uncertainty which may be of concern to fusion reactor technology. Other nuclides will be similarly examined and the information obtained will be used in cross section sensitivity studies for fusion reactor design. (auth)

46877 CIRCULAR POLARIZATION OF γ RAYS IN ^{18}F. A TEST FOR WEAK INTERACTION THEORIES. Wambach, U. M.; Gari, M.; Kuemmel, H. (Ruhr Univ., Bochum, Ger.). Phys. Lett.; 33B: No. 4, 253-6(26 Oct 1970).

The circular polarization from the transition of the (0^-, 0; 1.08 MeV) level to the (1^+, 0) ground state in ^{18}F has been computed with two-body matrix elements and short range correlations via the Bethe–Goldstone equation for finite nuclei. Results have been obtained for many different weak interaction theories. (auth)

46878 CHARGE FORM FACTOR AND QUADRUPOLE MOMENT OF ^{6}Li. Jain, A. K.; Sarma, N. (Bhabha Atomic Research Center, Bombay). Phys. Lett.; 33B: No. 4, 271-3(26 Oct 1970).

The charge density of ^{6}Li is calculated using antisymmetrized and modified cluster model wave functions. Satisfactory agreement with the measured charge form factor and quadrupole moment has been obtained. Exchange terms have been found to be important in both calculations. (auth)

46879 BETA-DELAYED PROTON DECAY OF ^{13}O: A VIOLATION OF MIRROR SYMMETRY. Esterl, J. E.; Hardy, J. C.; Sextro, R. G.; Cerny, J. (Univ. of California, Berkeley). Phys. Lett.; 33B: No. 4, 287-90(26 Oct 1970).

Beta-delayed protons, $E_{lab} > 1.2$ MeV, were observed following the decay of ^{13}O, $\tau_{\frac{1}{2}} = 8.95 \pm 0.20$ ms. Comparison of ^{13}O decay-rates with those of the mirror nuclide ^{13}B indicates a 15% deviation from mirror symmetry. (auth)

46880 SPECTRA OF NEUTRONS EMITTED AFTER MUON CAPTURE IN ^{16}O, ^{28}Si, ^{32}S AND ^{40}Ca. Hill, Lemmuel L. (Naval Ordnance Lab., Silver Spring, Md.); Ueberall, H. Nucl. Phys.; A190: No. 2, 341-61(1972).

On the basis of the particle-hole model for the closed-(sub)shell nuclei ^{16}O, ^{28}Si, ^{32}S and ^{40}Ca, a calculation of the partial muon-capture rates to the T = 1 states of the model (which mainly represent the giant resonance), as well as of the spectra of neutrons emitted in the decay of these states to the ground and excited states of the corresponding daughter nuclei is presented. Improved positions and empirical total widths for the resonant states have been used as obtained from photonuclear and electron scattering studies of the levels. The theoretical total muon-capture rates are in good agreement with measured rates. The calculated neutron spectra are compared to recently measured spectra following muon capture in ^{16}O, ^{32}S and ^{40}Ca. (auth)

46881 TEST OF TIME REVERSAL INVARIANCE THROUGH DETAILED BALANCE OF THE REACTION ^{12}C(α,γ)^{16}O. Von Wimmersperg, U.; Kernel, G.; Allardyce, B. W.; Mason, W. M.; Tanner, N. W. (Nuclear Physics Lab., Oxford). Phys. Lett.; 33B: No. 4, 291-3(26 Oct 1970).

The angular distributions of ^{12}C(α,γ)^{16}O and its inverse ^{16}O(γ,α) ^{12}C have been measured at an excitation of 13.1 MeV where there is a strong asymmetry favoring the forward direction due to E1/E2 interference. The asymmetries for (α,γ) and (γ,α) were the same within one standard deviation, and reveal no evidence of a failure of time reversal invariance. (auth)

46882 ENERGY LEVELS OF LIGHT NUCLEI A = 18 TO 20. Ajzenberg-Selove, F. (Univ. of Pennsylvania, Philadelphia). Nucl. Phys.; A190: No. 1, 1-196(1972).

A compilation of energy levels of A = 18, 19 and 20 nuclei, with emphasis on material leading to information about the structure of the A = 18–20 systems, is presented. (auth)

46883 ELASTIC SCATTERING OF ^{6}Li IONS. Davydov, V. V.; Novatskii, B. G.; Ogloblin, A. A.; (and others). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2399-2405(Nov 1971). (In Russian).

The elastic scattering of ^{6}Li ions with an energy of 30 MeV by the nuclei ^{12}C, ^{16}O, ^{28}Si, ^{40}Ca, ^{58}Ni, ^{120}Sn, ^{197}Au, and ^{208}Pb was studied. The maximum possible angles (170 to 175°) were attained in all cases. The scattering of 36.6 MeV α particles by ^{6}Li nuclei was similarly measured. The parameters of the Saxon–Woods potential are tabulated for each of the eight nuclei. (K.S.W.)

46884 EVIDENCE FOR SHAPE OR QUASIMOLECULAR RESONANCES IN THE ^{16}O + ^{16}O INTERACTION. Singh, P. P. (Indiana Univ., Bloomington); Sink, D. A.; Schwandt, P.; Malmin, R. E.; Siemssen, R. H. Phys. Rev. Lett.; 28: No. 26, 1714-17(26 Jun 1972).

Differential cross sections have been measured for the reaction ^{16}O(^{16}O,^{12}C)^{20}Ne leading to the first three states of ^{20}Ne at c.m. energies from 17.5 to 30 MeV and c.m. angles of approximately 62°, 76°, and 90°. The yield curves are characterized by (1) gross structures and narrow structures, and (2) strong angular and cross correlations. It is suggested that these results present direct evidence for shape or quasimolecular resonances in the ^{16}O + ^{16}O system. (auth)

46885 MECHANISM OF THE ^{9}Be(p,p$_1$)^{9*}Be 1.68 MeV REACTION. Vasil'ev, S. S.; Galakhmatova, B. S.; Dem'yanova, A. S.; (and others). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2364-7(Nov 1971). (In Russian).

Measurements of the angular distributions of elastic and inelastic scattering of protons by ^{9}Be nuclei were conducted at energies of 6.36 and 6.48 MeV and in the angular range 15 to 150°. The results of the measurements according to the excitation of the 1.68 MeV, $\frac{1}{2}^+$, level were compared with calculated values based on the mechanism characterized by a quadrangular diagram. (tr-auth)

46886 ORBITAL REARRANGEMENT IN LIGHT NUCLEI. Muether, H.; Goeke, K.; Faessler, Amand (Kernforschungsanlage, Juelich, Ger.). Z. Phys.; 253: No. 1, 61-70(1972).

Orbital rearrangement effects due to the removal of a proton are studied. Calculations for the nuclei ^{16}O, ^{20}Ne, and ^{40}Ca are performed using the Yale potential and the Brink–Boeker force B1. The odd-mass nuclei are not restricted to time reversal symmetry — in this way a large overestimation of the rearrangement energies is avoided. Although the orbital rearrangement energies are small (<1.5 MeV), by utilizing density-independent forces one can find larger changes in the wave functions due to the rearrangement, as exhibited in the discussion of the quadrupole moments and the mass distributions. (1 figure, 4 tables) (auth)

46887 INVESTIGATION OF TEMPERATURE DEPENDENCE OF CROSS SECTION OF COLD- AND THERMAL-NEUTRON SCATTERING BY O_2 AND D_2 MOLECULES. Vertebnyi, V. P.; Gul'ko, V. A.; Maistrenko, A. N.; Matviishina, N. N.; Razbudei, V. F. (Inst. of Nuclear Research, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 16: No. 12, 1967-74(Dec 1971). (In Russian).

The total cross sections for cold- and thermal-neutron scattering by biatomic gases (oxygen and deuterium) at temperatures of −100 to +100°C are reported. The measured cross sections are compared with those calculated by the theories of Krieger–Nelkin and Young–Koppel. (4 figures, 2 tables) (auth)

46888 ANGULAR AND ENERGY DISTRIBUTIONS OF PROTONS IN (γp) AND (ep) REACTIONS ON ^{12}C NUCLEUS FOR 130 MeV EXCITATION ENERGY. Egiyan, K. Sh.; Bochek, G. L.; Kulibaba, V. I.; Grishaev, I. A. (Inst. of Physics, Erevan). Physical-Technical Inst., Kharkov). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 6: No. 3, 161-7(1971). (In Russian).

The angular and the energy distributions of the secondary protons from (γ,p) and (e,p) reactions on ^{12}C at 130 MeV excitation energy are studied. The experimental results are compared with the quasi-deuteron and one-particle absorption models of γ quanta in the nucleus. For both cases the parameters of the proton wave function in the nucleus are estimated. (4 figures, 1 table) (auth)

46889 SOME REMARKS ON THE TRANSPARENCY OF COMPLEX NUCLEI TO PHOTOPRODUCED CHARGED PIONS AT INTERMEDIATE ENERGIES. de Carvalho, H. G. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro); Martins, J. B.; Tavares, O. A. P.; Nazareth, R. A. M. S.; di Napoli, V. Lett. Nuovo Cim.; 4: No. 9, 365-8(1 Jul 1972).

Nuclear transparencies of carbon-12, aluminum-27, manganese-55, ruthenium-100, and uranium-238 to photoproduced π^+ and π^- are calculated as functions of the energies of the respective particles. (L.B.S.)

46890 NEW EXPERIMENTAL DATA ON THE FINE STRUCTURE OF DIPOLE RESONANCE. Goryachev, B. I.; Ishkhanov, B. S.; Shevchenko, V. G. pp 362-78 of Problems of Modern Nuclear Physics. /Kolybasov, V. M. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

From second symposium on the problems of nuclear physics; Novosibirsk, USSR (12 Jun 1970).

Results are reported on cross section measurements on (γ,n)-

and (γ,p)-reactions obtained with a betatron for $E_{\gamma_{max}}$ = 35 MeV, in energy steps of 20, 50, and 100 keV. Light, average, and heavy nuclei were investigated with the above reactions: ^{12}C, ^{16}O, ^{24}Mg, ^{26}Mg, ^{27}Al, ^{28}Si, ^{31}P, ^{32}S, ^{40}Ca, ^{51}V, ^{52}Cr, ^{58}Ni, ^{60}Ni, Cu, ^{89}Y, ^{90}Zr, ^{93}Nb, $^{92,98}Mo$, $^{110-116}Cd$, ^{165}Ho, ^{166}Er, ^{181}Ta, ^{208}Pb. Cross sections were also measured for (γ,f)-reactions on ^{232}Th, ^{235}U, and ^{238}U. (K.S.W.)

46891 DIRECT REACTIONS INDUCED BY HIGH ENERGY PROTONS. Palevsky, Harry (Brookhaven National Lab., Upton, N. Y.). pp 423-43 of Problems of Modern Nuclear Physics. /Kolybasov, V. M. (ed.). Moscow; Izdatel'stvo Nauka (1971).

From second symposium on the problems of nuclear physics; Novosibirsk, USSR (12 Jun 1970).

Some experiments on direct nuclear reactions induced by high energy protons are surveyed. The type of information obtained in such experiments is discussed. Some conclusions regarding nucleon-nucleon correlations in nuclei which were drawn from the experiments are presented. (J.W.R.)

46892 QUADRUPOLE MOMENTS OF LIGHT NUCLIDES. **Ruehl, Franklin R. Jr. (Univ. of California, Los Angeles). Indian J. Phys.; 45: No. 4, 149-54(Apr 1971).**

As predicted by a trio of effective nucleon–nucleon interaction potentials, the quadrupole moments of seven light axially symmetric nuclei are analyzed. Based on agreement with experiment, the ground state shapes favored for these nucleides are then indicated. (auth)

46893 DEVELOPMENT OF A TWO-SECTION Ge(Li) COMPTON POLARIMETER WITH APPLICATIONS IN THE 2s–1d SHELL. **Lumpkin, Alexander Henderson. Baltimore; Johns Hopkins Univ. (1971). 121p. University Microfilms Order No. 72-16,910.**

Thesis.

A two-section Ge(Li) Compton polarimeter was developed, and its sensitivity to polarization was determined by an asymmetry calculation and a calibration with highly polarized gamma rays. This capability for absolute measurement of the linear polarization of gamma rays with high energy resolution was utilized experimentally with direct angular correlation measurements to study reaction gamma rays. Theoretical gamma ray linear polarization and angular distribution formulae in terms of the phase-defined reduced matrix elements of Rose and Brink are used in the analysis to determine, independently of the reaction mechanism, multipole mixing ratios of the gamma rays. These mixing ratios are compared in both magnitude and sign to the predictions of nuclear models. In particular gamma ray transitions of ^{19}F and ^{27}Al were studied. In ^{19}F the 1.459 MeV level was the major concern and the three transitions from this level which was populated by inelastic proton scattering were studied. The mixing ratios were determined to be $-0.1 < \delta_{M_2/E_1} < 0.0$ for the 1.459 → 0.197 MeV transition, $0.30 < \delta_{E_2/M_1} < 0.38$ for the 1.459 → 0.110 MeV transition, and $|\delta_{M_2/E_1}| < 0.06$ for the 1.459 → 0.0 MeV transition. The results indicate the level in question cannot be explained as a $p_{1/2}$ proton hole coupled to the pure ground state rotational band as has been accepted in the past. In ^{27}Al the transitions to the ground state from the 2.21, 2.73, 2.98, and 3.00 MeV levels were studied. Mixing ratios δ_{E_2/M_1} for the transitions were determined to be $\delta(2.21) = -0.57 \pm 0.08$, $\delta(2.73) = 0.22 \pm 0.09$, and $\delta(2.98) = 0.05 \pm 0.03$. The 3.00 MeV transition is apparently a pure E2 transition. These results are compared to the prediction of the rotational-vibrational model of Röpke. These applications demonstrate the usefulness of the two-part Ge(Li) polarimeter in the study of reaction gamma rays. (Diss. Abstr. Int., B)

46894 SMALL ANGLE INELASTIC SCATTERING OF 40 MeV PROTONS BY ^{12}C, ^{40}Ca, ^{56}Fe, AND ^{58}Ni. **Ingham, David Ransford. Santa Barbara, Calif.; Univ. of California (1971). 93p. University Microfilms Order No. 72-18,240.**

Thesis.

Angular distributions have been measured for inelastic scattering of 40 MeV protons to several states in ^{12}C, ^{40}Ca, ^{56}Fe and ^{58}Ni in the angular range from 6° to 20°. The scattered protons were stopped in a "stack" of three Si(Li) detectors and a computer was used to reject false events which had abnormal distributions of energy loss. The results are compared to DWBA calculations, to previous Coupled Channels calculations and to the Parity Rule. Discrepancies are noted between the data and the DWBA, but the Coupled Channels formalism appears capable of resolving these at least in part. (Diss. Abstr. Int., B)

46895 INVESTIGATION OF TWO NUCLEON TRANSFER REACTIONS IN ^{19}F USING 45 MeV PROTONS. **Huber, Kent Alvin. Los Angeles; Univ. of Southern California (1972). 149p. University Microfilms Order No. 72-17,474.**

Thesis.

The $^{19}F(p,^3He)$ and $^{19}F(p,t)$ reactions leading to the mirror nuclei ^{17}O and ^{17}F, respectively, were studied at a bombarding energy of 45 MeV. Absolute experimental differential cross sections were obtained for transitions to the ground, 0.871, 3.06, and 3.85 MeV levels of ^{17}O and to the ground, 0.500, 3.10, and 3.85 MeV levels of ^{17}F. Targets consisted of commercially available Teflon (CF_2) foils and target deterioration was carefully monitored. Data were collected for center-of-mass scattering angles between 10° and 110°. All distributions exhibit the strong forward peaking indicative of a direct transfer of two nucleons from the target to the incident probe. Total cross sections for the $^{19}F(p,^3He)$ reaction to the ground and 0.871 MeV states of ^{17}O were found to be 1.855 ± 0.005 millibarn and 0.660 ± 0.006 millibarn, respectively. Total cross sections for the $^{19}F(p,t)$ ground and 0.500 MeV transitions were measured as 2.58 ± 0.02 millibarn and 1.56 ± 0.09 millibarn. The experimental data are compared to the results of a DWBA analysis in which the initial nucleus is assumed to consist of an inert ^{16}O core with three nucleons in the $1d_{5/2}$ and $2s_{1/2}$ orbitals. The configuration of the ground state for both ^{17}F and ^{17}O assumed the ^{16}O core plus one nucleon in the $1d_{5/2}$ orbital. The first excited states assumed the inert core with one nucleon in the $2s_{1/2}$ orbital. Angular distributions are determined assuming the transfer of a heavy cluster of two nucleons. These calculations utilized the DWBA code JULIE and used optical model parameters from the literature to describe the elastic scattering in the entrance and exit channels. The predictions for the $^{19}F(p,t)$ ^{17}F L = O transfer to the 0.500 level exhibits the same oscillations as the data but fails to predict the correct magnitude. Results for the analogous $^{19}F(p,^3He)$ reaction to the 0.871 MeV levels also display the correct frequency but are displaced approximately 5° toward higher angles. Angular distributions predicted for the ground state L = 2 transitions are not as representative of the experimental results. (Diss. Abstr. Int., B)

46896 STUDY OF THE CONTINUUM STATES OF THE ^7Be SYSTEM BELOW 10 MeV. **Gintner, Henry. Cleveland; Case Western Reserve Univ. (1972). 103p. University Microfilms Order No. 72-18,692.**

Thesis.

A distorted wave Born approximation K-matrix formalism is employed to study the scattering states of the ^7Be system below 10 MeV. The ^7Be system is considered to be composed of three elementary particles: an α particle, a deuteron and a proton. Optical potentials that depend on angular momentum are used to describe the elastic scattering cross sections for ^6Li + p and ^4He + ^3He. A small D-state admixture in the ground state of ^6Li leads to a large resonant structure in the reaction $^4He(^3He,p)^6Li$ in the energy region corresponding to the $^4P_{3/2}$ level of ^7Be. The fit to the experimental cross sections in the region around the $^4P_{3/2}$ level is good. The K-matrix method is compared with the standard DWBA T-matrix method. The K-matrix method and the T-matrix method give essentially the same results outside the energy region of the $^4P_{3/2}$ level. In the energy region of the $^4P_{3/2}$ level the K-matrix method is superior since it takes into account the loss of flux from the incident channel to the outgoing channel. Inclusion of other channels and more cluster structures in ^6Li and ^7Be should lead to improved results. (Diss. Abstr. Int., B)

46897 $^3He(^6Li, \alpha p)^4He$ REACTION AT 1.54 MeV. Thompson, Daniel Thomas. Pullman, Wash.; Washington State Univ. (1972). 106p. University Microfilms Order No. 72-18,493.

Thesis.

Asymmetry in the proton yield about the ^5Li direction in the sequential reaction ($^3He + ^6Li \rightarrow \alpha_1 + ^5Li \rightarrow \alpha_1 + \alpha_2 + p$) has been measured for the ground and first excited states of ^5Li at a beam energy of 1.54 MeV. The initial reaction mechanism has been confirmed to be a pickup reaction in which the incoming ^3He picks up a neutron from the target ^6Li nucleus. A model based upon the physical aspects of the short lifetime of the ^5Li nucleus is capable of explaining the asymmetry for both the ground and first excited states of ^5Li. This model assumes that the ^5Li retains a "memory" of its formation and then shows that protons will be preferentially emitted forward of the direction of recoil of the ^5Li. The possibility that distorted wave Born approximation (DWBA) stripping theory may explain the asymmetric results has also been investigated. This is significant since the DWBA theory makes no assumptions about the lifetime of the ^5Li nucleus. The effects of Coulomb final state interactions (FSI) among the final state particles has been studied. Coulomb FSI do not contribute to the observed asymmetry, but they can significantly affect observed spectra for many reactions. An experimental technique has been developed which makes it possible to separate kinematically interfering events for three body final state reactions in which two or more of the final state particles are nonidentical. (Diss. Abstr. Int., B)

46898 EXPERIMENTAL INVESTIGATION OF THE ^{12}C-^{12}C REACTION AT LOW ENERGIES. Mazarakis, Michael Geras. Philadelphia; Univ. of Pennsylvania (1971). 203p. University Microfilms Order No. 72-17,396.

Thesis.

The reactions $^{12}C(^{12}C, \alpha)^{20}Ne$ and $^{12}C(^{12}C,p)^{23}Na$ have been studied in order to extend the available excitation curves down to lower energies and to provide reliable predictions of the reaction cross sections in the energy region of interest for stellar thermonuclear carbon burning. A carbon foil target of about 30 $\mu gr/cm^2$ (65 $\mu gr/cm^2$ for measurements of $E_{c.m.} < 2.8$ MeV) was bombarded with a beam of $^{12}C^{++}$ of 0.5 – 1 μAmp. from the University of Pennsylvania Tandem Accelerator. The measurements covered a range of 2.4 to 5 MeV in the center-of-mass in steps of 125 keV. Many excited state transitions have been observed for the protons and alpha particles. The spectra of protons and alphas were obtained at eight forward laboratory angles: 20°, 30°, 40°,. . .90°. Four silicon solid state detectors were used in two successive runs for each energy studied. The obtained angular distributions were transformed separately to the center-of-mass system and integrated to give the total cross sections for the alpha particles and protons. The present measurements give cross sections in agreement with those obtained by J. R. Patterson, H. Winkler and C. S. Zaidins in the overlapping region and extend the available information to the actual static astrophysical region (hydrostatic carbon burning). The obtained cross sections, corrected for the transmission probability of the Coulomb barrier (nuclear factor $\bar{S}$), show a continuation of the prominent "structure" observed near 6 MeV by E. Almqvist, D. A. Bromley and J. A. Kuehner. Below 3 MeV an increase of the factor $\bar{S}$ was observed with a possible maximum near 2.4 MeV and a corresponding total reaction cross section of the order of 10^{-8} barns. This coincides with sharp resonances separately observed in the compound ^{24}Mg nucleus in the $^{16}O(^{12}C,\alpha)^{24}Mg$ reaction. The comparison of the branching ratios measured in the present work with those of the above resonances does not preclude a similar origin. The excitation functions of the different reaction products were analyzed in detail and two intermediate resonances were found below 5 MeV at 4.17 and 4.9 MeV with the same properties as those found near 6 MeV. A spin assignment was carried out and a possible $J^+ = 4^+$ has been suggested. A phenomenological analysis of the present results (reaction cross sections and branching ratios) has recently been carried out by G. J. Michaud and E. W. Vogt (M6) based on an $\alpha-\alpha$ model interaction. The main conclusions of this paper are discussed with the presentation of the experimental results. (Diss. Abstr. Int., B)

46899 STUDY OF THE $^{16}O(d,n)$ REACTION FROM 3 TO 4 MeV. Anderson, Bryon Don. Cleveland; Case Western Reserve Univ. (1972). 109p. University Microfilms Order No. 72-18,666.

Thesis.

The cross sections and polarizations of the neutron groups from the $^{16}O(d,n)^{17}F$ reaction leading to the ground and first excited states of ^{17}F have been measured in the deuteron energy range from 3 to 4 MeV. Angular distributions were determined at three energies. Excitation functions of cross sections at two angles and of polarizations at one angle were performed. Time-of-flight techniques were employed throughout. The neutron polarimeter for the polarization measurements consisted of a gas helium-xenon scintillator with two plastic-scintillator side detectors. Calculations were performed to determine to what extent the DWBA theory could describe the experimental results. The cross-section angular distributions and the highest energy ground state polarization angular distribution could all be reproduced simultaneously with only small modifications made to optical-model parameters taken from recent elastic-scattering data analyses. The rest of the polarization data appears to be affected by large compound-nucleus contributions and could not be reproduced simultaneously. Spectroscopic factors were extracted and are in satisfactory agreement with those obtained by previous workers. (Diss. Abstr. Int., B)

46900 SEARCH FOR PARITY AND ISOBARIC SPIN VIOLATING DECAY OF THE 3,56 MeV LEVEL IN ^6Li. Kosiara, Andrzej. Cleveland; Case Western Reserve Univ. (1972). 59p. University Microfilms Order No. 72-18,703.

Thesis.

The self interacting current-current theory of weak interactions predicts the existence of a parity violating force between nucleons. A technique utilizing time-of-flight in addition to the usual energy and particle identification has been applied to the investigation of the decay of the 3.56 MeV, O^+, T = 1 level in ^6Li. This level is forbidden by conservation of parity and isobaric spin to break up into a deuteron and an alpha particle. It was populated via the $^9Be(p,\alpha)^6Li$ (3.56 MeV) reaction. The proton beam of 2.56 MeV energy was supplied by the CWRU Van de Graaff accelerator at a 1 Mhz repetition rate. This beam when reaching the target has a further time structure which consisted of 1 ns long groups of particles separated in time by 100 nsec. Most of the protons are contained in one group, called the main pulse. This group would be the most desirable to populate the 3.56 MeV in ^6Li. The subsequent parity-forbidden breakup would have to be investigated in the presence of the intense background due to elastically scattered protons. The high intensity of the elastically scattered protons from the main pulse introduces nearly 100% dead time in the electronic analysis and makes detection of a parity-forbidden event difficult. This problem could be circumvented by operating the accelerator at low current but this introduces beam instability which makes it impossible to interrelate data. The experiment was performed by electronically gating out the elastically scattered protons due to the main pulse. The products of the bombardment of the beryllium target by the subsequent 10 Mhz proton groups were observed with a scintillation detector. The low intensity of the elastically scattered protons due to those groups permitted keeping the dead time of the multichannel analyzer less than 2%. The data consist of time-of-flight spectra with the part due to the main pulse gated out. They were analyzed by the least-squares technique for the presence of deuterons from the forbidden breakup. The background was obtained by observing gated time-of-flight spectra of the same reaction at the energy where the population of the 3.56 MeV level is unlikely. No evidence of the forbidden breakup has been observed. The limit on joint parity and isobaric spin conservation is $^2F \sim 8.1 \times 10^{-6}$. (Diss. Abstr. Int., B)

46901 NUCLEAR SPINS AS DETERMINED BY THE METHOD OF GAMMA–GAMMA ANGULAR CORRELATIONS. Spyr, David Jon. Iowa City, Iowa; Univ. of Iowa (1972). 110p. University Microfilms Order No. 72-17,606.

Thesis.

The method of gamma-gamma angular correlations (Litherland and Ferguson, method I) was used to make spin determinations for levels in ^{10}B, ^{23}Na, and ^{42}K. The quadrupole/dipole amplitude mixing ratios for each transition were also measured as well as the magnetic substate populations for the initial decaying level. A new and flexible computer-based data taking system was employed to make the first measurement for the ^{42}K levels and to confirm the rest. The levels investigated together with the most probable or accepted spins were: $^{10}B_{1.740\rightarrow 0.717\rightarrow 0.0}$ (0, 1, 3); $^{23}Na_{2.390\rightarrow 0.439\rightarrow 0.0}$ ($\frac{1}{2}$, $\frac{5}{2}$, $\frac{3}{2}$); $^{42}K_{0.252\rightarrow 0.104\rightarrow 0.0}$ (4, 3, 2). (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts: 46486, 46664, 46873, 46875, 46880, 46882, 46883, 46886, 46889, 46890, 46892, 46893, 46901, 46924, 46929, 47066, and 47072.

46902 (BARC–598) STUDIES ON ANALOG STATES IN ^{33}Cl BY ISOSPIN-FORBIDDEN RESONANCES IN THE REACTION $^{32}S(p,\gamma)^{33}Cl$. Eswaran, M. A.; Ismail, M.; Ragoowansi, N. L. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 26p. Dep. NTIS (U. S. Sales Only).

The residual activity between bursts of a mechanically chopped beam was used to measure the yield of the reaction $^{32}S(p,\gamma)^{33}Cl$ systematically in the bombarding energy range E_p = 3.36 to 5.41 MeV. Two T = $\frac{3}{2}$ states in ^{33}Cl at E_p = 3.371 ± 0.005 MeV, E_x = 5.550 ± .007 MeV and at E_p = 5.282 ± .006 MeV, E_x = 7.402 ± .008 MeV were located with the resonance strengths $(2J + 1)\Gamma_p\Gamma_\gamma/\Gamma$ = 0.76 ± 0.18 eV and 1.50 ± 0.37 eV, respectively. Each of these resonances was narrower than the estimated 2 keV spread in the proton beam. These two states are interpreted as the analogs of the ground state and the second excited state of ^{33}P with J^π values of $\frac{1}{2}^+$ and $\frac{5}{2}^+$, respectively. γ decay of the lower resonance, investigated with a Ge(Li) detector, shows >88% and <12% branchings to the first excited state and ground state of ^{33}Cl, respectively. The M1 strengths of these transitions are compared with those obtained from beta analog transitions and with the theoretical predictions based on many-particle shell-model calculations. (5 figures, 4 tables) (auth)

46903 (COO–1120-149) FINAL REPORT. (Kansas Univ., Lawrence. Nuclear Structure Lab.). Jun 1972. Contract AT-(11-1)-1120. 91p. Dep. NTIS.

MAGNESIUM-24 — energy levels from sodium-23 (p,γ) reactions, widths and spin-parity assignments for, (E)

NITROGEN-14 — proton reactions (p,γ) at 3.1 to 3.5 MeV, γ spectra and excitation function for, (E)

— proton inelastic scattering at 3.1 to 3.5 MeV, excitation function for, (E)

OXYGEN-15 — energy levels at 10.275, 10.459, and 10.466 MeV from nitrogen-14 (p,γ) reactions, spin-parity assignments and decay properties of, (E)
PROTONS — scattering by sodium-23 at 1.4 to 3 MeV, resonance structure in excitation functions for elastic and inelastic, (E)
SODIUM-23 — proton reactions (p,γ) at 1.8 to 2.8 MeV, γ yields for, (E)
— proton reactions (p,α) at 1.4 to 3 MeV, resonance structure in excitation functions for, (E)
— proton elastic and inelastic scattering at 1.4 to 3 MeV, resonance structure in excitation functions for, (E) (J.W.R.)

46904 ENERGY LEVELS OF ^{36}K. Dzubay, T. G. (Duke Univ., Durham, N. C. Triangle Universities Nuclear Lab., Durham, N. C.); Jaffe, A. A.; Ludwig, E. J.; (and others). Phys. Lett.; 33B: No. 4, 302-4(26 Oct 1970).

The ^{36}Ar(^{3}He,t)^{36}K reaction has been observed at 22.17 MeV, and a Q value of −12.93 ± 0.04 MeV deduced. Excited states in ^{36}K were seen at 0.800, 1.115, 1.59, 1.67, 1.89, 2.27, 2.41, 2.56, 2.85 and 3.35 MeV. A comparison is made with levels in ^{36}Cl. (auth)

46905 LIFETIME OF THE 1.013-MeV STATE IN ^{27}Al. Kaipov, D. K.; Kosyak, Yu. G.; Smirin, L. N.; Shubnyi, Yu. K. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2323-4(Nov 1971). (In Russian).

In an investigation of the γ resonance scattering by ^{27}Al the lifetime of the 1.013 MeV level was determined as $\tau = 1.22 \times 10^{-2}$ sec. Radioactive ^{27}Mg was used as the source of the γ radiation. (tr-auth)

46906 LOW-LYING POSITIVE-PARITY STATES OF ^{34}Cl AND ^{36}Cl FROM (p,d) REACTIONS AND SHELL-MODEL INTERPRETATIONS. Vignon, B. (Institut des Sciences Nucleaires, Grenoble, France); Longequeue, J. P.; Towner, I. S. Nucl. Phys.; A189: No. 3, 513-25(1972).

Low-lying positive-parity states of ^{34}Cl and ^{36}Cl nuclei have been studied from the ^{35,37}Cl(p,d) reactions. A DWBA analysis of the angular distributions for the strong transitions has been performed and spectroscopic factors deduced. The experimental results have been compared with shell-model calculations in the $2s_{\frac{1}{2}} - 1d_{\frac{3}{2}}$ vector space, and with recent calculations involving the full s−d shell. Most of the excitation energies and spectroscopic factors were successfully reproduced. (auth)

46907 STUDY OF EXCITED STATES OF ^{21}Ne. Rolfs, C. (Univ., Freiburg i. B. Univ. of Toronto); Trautvetter, H. P.; Kuhlmann, E.; Riess, F. Nucl. Phys.; A189: No. 3, 641-64 (1972).

The 2.79, 3.66, 3.73 and 3.88 MeV states in ^{21}Ne have been studied with the ^{18}O(α,nγ)^{21}Ne reaction at E_α = 4.9 to 6.6 MeV. Both neutrons and γ-rays were observed. The investigation involved measurements of γ-ray angular distributions as well as nγ and γγ angular correlations for procuring spin and multipole mixing information. The results of this investigation combined with previous work lead to respective J^π assignments of $\frac{1}{2}^-$, $\frac{3}{2}^-$, $\frac{5}{2}^+$ and $\frac{5}{2}^-$. The states above 4 MeV excitation energy have been studied at E_α = 7.5 to 11.5 MeV with a Ge(Li)−NaI(Tl) pair spectrometer. Two new states at E_x = 5525.0 ± 1.5 and 5682 ± 2 keV have been found. Evidence is also presented for a doublet comprising the states with excitation energies 5821 ± 3 and 5823 ± 3 keV. Excitation energies, γ-ray decay schemes, mean-lives and limits on spin assignments to all the states are reported. Some of the results are compared with the available data for the mirror nucleus ^{21}Na and discussed in terms of the rotational model. (auth)

46908 LIFETIME OF THE 975-keV, $\frac{1}{2}^+$ STATE IN ^{25}Mg. Alexander, T. K.; Haeusser, O.; MacDonald, A. B.; Yuang, J. T. (Chalk River Nuclear Labs., Ont.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2287-91(Nov 1971). (In Russian).

Measurements were made using the reaction ^{2}H(^{24}Mg, pγ)^{25}Mg in which the velocity of the nucleus of recoil ^{25}Mg was 5.5% of the velocity of light. From the results of direct measurements of the lifetimes pertaining to the decays 975 → 585 and 975 → 0 the averaged lifetime of the 975 state was 14.6 ± 1.5 psec. (K.S.W.)

46909 GAMMA-SPECTRA AND CROSS SECTION OF THE (n,n′γ) REACTION IN THE ISOTOPES ^{27}Al, ^{51}V, ^{52}Cr, ^{55}Mn, ^{56}Fe, ^{93}Nb, ^{208}Pb, AND ^{209}Bi. Degtyarev, Yu. G.; Protopopov, V. N. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2341-4(Nov 1971). (In Russian).

The excitation of the low-lying levels of the eight isotopes ^{27}Al, ^{51}V, ^{52}Cr, ^{55}Mn, ^{56}Fe, ^{93}Nb, ^{208}Pb, and ^{209}Bi was investigated during inelastic scattering of neutrons with energies of from ~0.6 to ~3.4 MeV. The measurements were conducted at standard ring geometry in an electrostatic accelerator. The γ spectra from the (n,n′γ) reactions were detected with a Ge(Li)-spectrometer using a 2.5 cm^3 crystal. The absolute cross sections of excitation of all γ transitions were determined through a comparison of their yield with the intensity of the 846 keV line from ^{56}Fe. (K.S.W.)

46910 INVESTIGATION OF THE GAMMA DECAY OF EXCITED STATES IN ^{25}Al. Piiparinen, M. (Univ. of Helsinki). Z. Phys.; 252: No. 3, 206-18(1972).

The gamma decay of the low-lying energy levels (E_x < 4 MeV) in ^{25}Al was studied through the ^{24}Mg(p,γ)^{25}Al reaction by using seven resonances in the proton energy range E_p = 200 to 1700 keV. Ge(Li) detectors and isotopically separated targets were used. Energies and branching ratios of several excited states were measured. The Q value of the reaction was determined to be 2271.3 ± 0.8 keV. Lifetimes, investigated by the Doppler-shift attenuation method, and γ-ray angular distributions were determined using the E_p = 823, 1201, 1490, and 1660 keV resonances of the ^{24}Mg(p,γ)^{25}Al reaction. (4 figures, 5 tables) (auth)

46911 BETA DECAY ASYMMETRY AND NUCLEAR MAGNETIC RESONANCE OF ^{28}Al, ^{38}Cl, AND ^{116}In PRODUCED BY CAPTURE OF POLARIZED NEUTRONS. Lades, Heinrich (Technische Univ., Munich). Z. Phys.; 252: No. 3, 242-8 (1972). (In German).

Polarized ^{28}Al, ^{38}Cl, and ^{116}In nuclei were produced by capture of polarized thermal neutrons. The nuclear magnetic resonance was observed by measuring the asymmetry of the β decay. The nuclear magnetic moments were found to be $\mu(^{28}\text{Al})$ = 2.789(1) nm and $\mu(^{38}\text{Cl})$ = 2.05(2) nm (uncorrected). The β-decay asymmetry of ^{116}In was observed in superconducting In metal. (5 figures) (auth)

46912 K^-–NUCLEUS SCATTERING LENGTHS. Seki, Ryoichi (California State Univ., Northridge). Phys. Rev. Lett.; 29: No. 4, 240-3(24 Jul 1972).

K^-–nucleus scattering lengths are extracted from all K^--mesonic atom data currently available. The scattering lengths obtained are shown to be model independent as long as the K^-–nucleus optical potential is local. (auth)

46913 (^{16}O,^{12}C) STUDIES IN THE 2s–1d SHELL. Maher, J. V.; Erb, K. A.; Wedberg, G. H.; Ricci, J. L.; Miller, R. W. (Univ. of Pittsburgh). Phys. Rev. Lett.; 29: No. 5, 291-5(31 Jul 1972).

Angular distributions were measured for the (^{16}O,^{12}C) reactions with ^{24,26}Mg, ^{27}Al, and ^{28}Si at 42 MeV. States in the "α-particle" nuclei ^{28}Si and ^{32}S were populated strongly for $0 \le E_x \le 11$ MeV, while cross sections for transitions to states in ^{30}Si and ^{31}P were small. The ^{28}Si and ^{32}S ground-state angular distributions are sharply oscillatory in nature. The 4.43-MeV state of ^{12}C is strongly excited in the reaction ^{24}Mg(^{16}O,^{12}C)^{28}Si, but not in the others. (auth)

46914 NEW RESULTS ON THE FINE STRUCTURE OF ANALOG RESONANCES. Bilpuch, E. G. (Duke Univ., Durham, N. C. Triangle Universities Nuclear Lab., Durham, N. C.). pp 318-49 of Problems of Modern Nuclear Physics. /Kolybasov, V. M. (ed.). Moscow; Izdatel'stvo Nauka (1971).

From second symposium on the problems of nuclear physics; Novosibirsk, USSR (12 Jun 1970).

High-resolution experiments on proton elastic scattering by A = 20 to 66 nuclei have been performed at proton energies of 1 to 3.3 MeV. The fine structure of isobaric analog resonances observed in these experiments is discussed. (J.W.R.)

46915 NUCLEAR STRUCTURE OF ^{23}Na: CHARGED PARTICLE REACTION STUDIES. Powers, John Richard. Philadelphia; Univ. of Pennsylvania (1971). 265p. University Microfilms Order No. 72-17,412.

Thesis.

The nuclear structure of ^{23}Na has been studied using single-proton, two-nucleon, three-nucleon, and four-nucleon stripping in the ^{22}Ne(^{3}He,d)^{23}Na ($E_{^3He}$ = 15 MeV), ^{21}Ne(^{3}He,p)^{23}Na ($E_{^3He}$ = 18 MeV), ^{20}Ne(^{7}Li,α)^{23}Na ($E_{^7Li}$ = 22 MeV), and ^{19}F(^{6}Li,d)^{23}Na ($E_{^6Li}$ = 16 MeV) reactions and using proton pickup in the ^{24}Mg(t,α)^{23}Na (E_t = 15 MeV) reaction. The ^{25}Mg(d,α)^{23}Na (E_d = 11.57, 11.82, and 12.07 MeV) and ^{12}C(^{12}C,p)^{23}Na ($E_{^{12}C}$ = 30 MeV) reactions were also studied. Angular-momentum transfer values were obtained from the systematics of the (^{3}He,d), (^{3}He,p), (t,α), (^{6}Li,d), and (^{7}Li,α) angular distributions. The cross sections of states of known spin obtained from the (d,α) reaction were shown to vary in accord with the (2J + 1) rule. Restrictions on the spin of unknown levels were then determined using this rule. By combining results several new spin-parity assignments were made. Transition strengths were obtained by a comparison of the experimental angular distributions with DWBA predictions for the (^{3}He,d),

(t,α), and (^{6}Li,d) reactions and with PWBA predictions for the (^{7}Li,α) reaction. The pickup and stripping strengths obtained from these studies enabled a detailed analysis of the configuration of many states as predicted by the Nilsson model and shell model. Significant revision of previous understanding of the negative-parity state was proposed. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts: 46848, 46873, 46875, 46883, 46886, 46889, 46890, 46894, 46901, 46909, 46914, 46932, 46934, 46936, 46940, and 47069.

46916 (AE-452) FAST NEUTRON ELASTIC SCATTERING EXPERIMENTS. Salama, M. (Aktiebolaget Atomenergi, Studsvik (Sweden)). 1972. 98p. Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Cairo Univ. (Egypt).

In the present study measurements were carried out on fast neutron elastic scattering angular distributions of the elements Cr, Fe and Ni in the energy interval 1.77 to 2.76 MeV and of As, Nb, Mo, Cd, Sb, Hf, Au, Pb, (radiogenic lead) and Pb at 8.05 MeV, using the time-of-flight technique. The fast neutrons were produced with the T(p,n)^{3}He and the D(d,n)^{3}He reactions using gas targets. The neutrons were scattered by hollow right cylindrical samples of the natural elements. The scattered neutrons were detected with a fast plastic scintillator discriminated against gamma rays to reduce background. The elastic scattering effect was separated from the inelastic scattering processes by use of a time-of-flight spectrometer. The spectrometer time resolution was about 3 ns. The angular distribution measurements were performed in the angular interval ranging from 20° to 160° with 3 meters flight path. The experimental data were collected in steps of 10° while in the extreme forward directions the data were taken every 5°. The experimental data were normalized and were corrected for background. Various corrections due to neutron attenuation in the sample, neutron multiple scattering and the finite geometry of the source-sample-detector system were applied to the measured distributions in order to derive accurate absolute cross sections. The corrected measured angular distributions were compared with the distributions calculated using a nuclear optical model assuming a central local potential consisting of Saxon-Woods and derivative Saxon-Woods and Thomas form factors describing the real, imaginary and spin orbit potentials. The numerical calculations were made using the ABACUS II computer code. From the nuclear structure point of view, the elastic scattering data were examined to obtain information upon the distribution of neutrons and protons inside nuclei. The extension of the matter and charge distributions have been calculated for Sb and Au from neutron and electron root-mean-square radii confirming other observations that the mass distribution extends beyond that of the nuclear charge distribution. It has also been confirmed that the difference between the root-mean-square matter and charge radii increases somewhat with the neutron excess in nuclei. (auth)

46917 (BNL-tr-477) γ-EMISSION IN RADIATIVE CAPTURE OF INTERMEDIATE NEUTRONS. Gamalii, A. F.; Zemtsev, B. V.; Ivanov, V. B.; Netserov, B. V.; Kham'yanov, L. P. Translated by S. J. Amoretty (Brookhaven National Lab., Upton, N. Y.), from Yadern. Fiz.; 15: No. 1, 3-9(1972). 12p. Dep. NTIS.

The spectra of the capture gamma rays from radiative capture of thermal neutrons and of neutrons with energies 2 and 25 keV by ^{95,97}Mo, ^{62}Ni, ^{48}Ti nuclei were studied using a γ spectrometer with a Ge(Li) detector. The neutrons with average energies of 2 and 25 keV were selected from the solid reactor spectrum with the help of scandium and ferroaluminum filters. (3 figures, 1 table) (auth)

46918 (JEN-230-DMe/I-25) TABLE OF CROSS SECTION (n,p), (n,α), AND (n,2n) REACTIONS IN STEEL COMPONENTS AND OTHER NUCLEAR MATERIALS. Lopez Jimenez, Jose (Junta de Energia Nuclear, Madrid (Spain). Division de Metallurgia). 1972. 35p. (In Spanish). Dep. NTIS (U. S. Sales Only).

Reactions (n,p) and (n,α) produce in the materials large amounts of hydrogen and helium atoms. The presence, especially of helium, changes the physical properties of materials and particularly reduces the ductility of irradiated stainless steel cladding above 500°C. Cross sections of all isotopes which constitute the S. S. and other clad materials, have been compiled. Experimental available data were obtained from BNL (1956, 64 and 68), and the rest, from J. C. Roy and J. J. Hawton calculations in a fission neutron spectrum (1960). By the Fortran IV program COFRE, the fission-spectrum-averaged cross section of experimental data and the average values in lethargy constant intervals were obtained. The estimated cross section of ROY has been transformed to threshold "equivalent" cross sections using the effective energy E_{eff}. These data will be the in-put data of PROTALFA program, which determine the amount of H and He gas produced by the interactions of thermal and fast neutron flux in S. S. and other clad alloys. (auth)

46919 FURTHER RESULTS ON THE PROTON RADIOACTIVITY OF ^{53m}Co. Cerny, Joseph; Gough, R. A.; Sextro, R. G.; Esterl, John E. (Univ. of California, Berkeley). Nucl. Phys.; A188: No. 3, 666-72(1972).

Additional studies on the proton radioactivity of the 247 ± 12 msec isomer ^{53m}Co lead to an improved estimate of ≈17 sec for its partial half-life for emission of 1.59 ± 0.03 MeV protons to the ^{52}Fe ground state. An upper limit of 1/250 for the ratio of direct proton decay to the ^{52}Fe*(2$^+$, 0.84 MeV) state relative to decay to the ^{52}Fe(g.s.) can be set. (auth)

46920 ENERGY OF LEVELS OF ^{45}Sc UP TO 3 MeV FROM THE ^{44}Ca(p,γ)^{45}Sc REACTION. Ekstroem, P.; Erlandsson, B.; Marcinkowski, A.; Tillman, J. (Univ. of Lund, Sweden). Z. Phys.; 252: No. 3, 189-205(1972).

The gamma-ray decay of the 1658-keV resonance, which is a member of the isobaric analogs of the 1904-keV $^3/_2^-$ level in ^{44}Ca, was studied with a Ge(Li) detector. A number of gamma-ray transitions are described and associated with the decay of 15 levels between 1.50 and 3.05 MeV. These observations made it possible to deduce spin and parity assignments for some of the levels. By comparing excited levels of ^{43}Sc and ^{45}Sc it was possible to assign certain levels as members of one negative-parity band and two positive-parity bands with $K^\pi = 1/2^+$ and $3/2^+$. (9 figures, 2 tables) (auth)

46921 THEORETICAL COEFFICIENTS OF INTERNAL CONVERSION FOR ^{51}V. Trusov, V. F. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2338-40(Nov 1971). (In Russian).

Internal conversion coefficients were found for ^{51}V in K-, L_{I-III}-, and M_I-subshells of the first two multipole orders or electrical and magnetic transitions in the energy range 0.05 to 1 m_oc^2. Screening was taken into account using the Gashpar analytical potential in a variant of non-linear deformation of effective charge. The transition M1-E2 with an energy of 320 keV was examined, for which experimental data exist. (tr-auth)

46922 ELASTIC AND INELASTIC SCATTERING OF 6-MeV PROTONS BY THE EVEN ISOTOPES OF CHROMIUM. Antropov, A. E.; Zarubin, P. P.; Ioanmu, P. D.; Orlov, B. N.; Romanov, V. S. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2355-8 (Nov 1971). (In Russian).

The energy and angular distribution of elastic and inelastic scattering of 6 MeV protons by the isotopes ^{50,52,54}Cr were measured. Peculiarities were discovered which were successfully explained by the different contribution to the scattering of indirect processes depending on the magnitude of the threshold of the (p,n) reaction. (tr-auth)

46923 EFFECT OF DIFFUSION OF THE BOUNDARY OF A NUCLEUS AND THE COULOMB INTERACTION ON THE DIFFRACTION DISINTEGRATION OF DEUTERONS. Berezhnoi, Yu. A.; Evlanov, M. V. (Physical-Technical Inst., Kharkov. Inst. of Nuclear Research, Kiev). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2406-9(Nov 1971). (In Russian).

A mathematical development led to the calculation of the differential cross section of elastic scattering of 100 MeV deuterons by ^{58}Ni nuclei under three different assumptions: the possession by the nucleus of a sharp boundary but without allowing for the Coulomb interaction of the deuteron with the nucleus, the existence of a diffuse boundary for the nucleus but without allowing for deuteron-nucleus interaction, and the existence of a diffuse nuclear boundary, and making allowance for the Coulomb interaction. The third case significantly changed the behavior of the differential cross sections of interaction processes between deuterons and nuclei, and this fact may prove to be important in the comparison of theoretical results with experimental data. (K.S.W.)

46924 ELASTIC SCATTERING OF POLARIZED PROTONS BY ^{28}Si AND ^{40}Ca. Klucharev, A. P.; Slabospitskii, R. P.; Andreev, G. G.; (and others) (Physical -Technical Inst., Kharkov, USSR). Ann. Phys. (N. Y.); 71: No. 2, 438-42(Jun 1972).

Proton polarization was measured for elastic scattering of polarized protons in the reaction ^{28}Si(p,p)^{28}Si in the energy region 1.5 to 3.0 MeV and in ^{40}Ca(p,p)^{40}Ca in the energy region 2.3 to 2.8 MeV at angles of 60° and 90° c.m. As a result of the investigation, the total angular momentum for excited states of ^{29}P, $J^\pi = 3/2^-, 1/2^+, 1/2^-$, was determined. For states of ^{41}Sc with

energies of 3.729 and 3.769 MeV, $J^\pi = 1/2^-$. But instead of the state at 3.467 MeV, two states with energy excitation 3.460 and 3.475 MeV with $J^\pi = 1/2^-$ were discovered. All four investigated levels of ^{41}Sc obviously are terms of multiplet of one-particle excited state. Phase-shift analyses made it possible to obtain widths for the levels from the energy dependence of the polarization for the levels investigated. (3 figures) (auth)

46925 ^{53m}Co: A PROTON-UNSTABLE ISOMER. Jackson, K. P. (Oxford Univ.,); Cardinal, C. U.; Evans, H. C.; Jelley, N. A.; Cerny, J. Phys. Lett.; 33B: No. 4, 281-3(26 Oct 1970).

A 1.53 ± 0.04 MeV proton activity with a 245 ± 20 ms half-life has been observed in the reaction of ^{16}O on ^{40}Ca. The most plausible origin of this activity is the proton radioactivity of ^{53m}Co, although the decay of this isomer by beta-delayed proton emission remains a possibility. (auth)

46926 CONFIRMED PROTON RADIOACTIVITY OF ^{53m}Co. Cerny, J.; Esterl, J. E.; Gough, R. A.; Sextro, R. G. (Univ. of California, Berkeley). Phys. Lett.; 33B: No. 4, 284-6(26 Oct 1970).

Proton-induced reactions on ^{54}Fe produce a proton activity [1.57 ± 0.03 MeV; 242 ± 15 ms] with a threshold of 26.3 ± 0.4 MeV which can only arise from ^{53m}Co. Failure to detect positron-proton coincidences in the decay of this isomer establishes its direct proton radioactivity. (auth)

46927 ^{58}Ni(α,α')^{58}Ni AND THE NATURE OF HIGH-LYING STATES IN ^{58}Ni. Bruge, G.; Chaumeaux, A.; DeVries, R.; Morrison, G. C. (CEN de Saclay, Gif-sur-Yvette, France). Phys. Rev. Lett.; 29: No. 5, 295-8(31 Jul 1972).

Levels in ^{58}Ni up to 10 MeV excitation energy were studied through the (α,α') reaction at 30 MeV; surprising overall agreement between the observed spectra and those from α-transfer reactions was found. (auth)

46928 MISSING LOW-LYING STATES IN ^{39}K. Durell, J. L. Max-Planck Institut fuer Kernphysik, Heidelberg); Metag, V.; Repnow, R.; (and others). Phys. Rev. Lett.; 28: No. 26, 1723-5 (26 Jun 1972).

The previously known levels of ^{39}K at 3.94 and 4.52 MeV have been shown to be doublets. Two of these levels are candidates for the missing low-lying negative-parity states predicted by shell-model and phonon-hole calculations. (auth)

46929 ANGULAR DISTRIBUTION OF NEUTRONS FROM (p,n) REACTIONS ON ^{18}O, ^{37}Cl, ^{41}K, ^{53}Cr, AND ^{59}Co NUCLEI. Dryapachenko, I. P.; Nemets, O. F.; Pilipchenko, V. A. (Inst. of Nuclear Research, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 16: No. 12, 1947-52(Dec 1971). (In Russian).

Angular distributions of neutrons from (p,n) reactions with ^{59}Co, ^{53}Cr, ^{18}O nuclei and total cross sections for the reactions ^{59}Co(p,n)^{59}Ni and ^{53}Cr(p,n)^{53}Mn at energies from 2.8 MeV to 4 MeV were measured by means of the long counter and the single-crystal scintillation spectrometer. Angular distributions of neutrons from (p,n) reactions with ^{37}Cl, ^{59}Co, and ^{41}K to ground states of the final nuclei at proton energies of 3.7 MeV and 3.9 MeV were also measured with the single-crystal scintillation spectrometer. The influence of the interference effects on the angular distributions from the reactions ^{37}Cl(p,n)^{37}Ar and ^{18}O(p,n)^{18}F was observed. For the remaining nuclei the angular distributions slightly differ from isotropic ones. The results of the measurements are compared with the data of other authors. (7 figures) (auth)

46930 NUCLEAR STRUCTURE AND REACTION MECHANISM STUDIES USING THE (^{3}He,t) REACTION. Fadner, Willard Lee. Boulder, Colo.; Univ. of Colorado (1971). 214p. University Microfilms Order No. 72-17,256.

Thesis.

Transitions to the isobaric analog ground states of ^{46}Ti, ^{50}Cr, ^{54}Fe, ^{62}Ni, ^{64}Ni and ^{90}Zr, and to several excited states of the particle-hole mirror nuclei ^{46}V and ^{50}Mn were studied with the (^{3}He,t) reaction over the energy range of 21.4 to 37.5 MeV. For the transitions to the isobaric analog ground states, unexpected and complex variations in the shapes of the experimental angular distributions were observed. The variations in the shape as a function of energy had distinct features for each of the nuclei examined. These effects were poorly described by DWBA calculations based on a simplified shell-model theory (microscopic model). Calculations based on a generalized optical model theory (macroscopic model), using different interaction terms for each nucleus, gave a somewhat better description. Interaction strengths, normalized to fit the data, required a significant decrease with increasing incident energy for both theoretical models. This effect, documented herein, has been a major factor in variations in interaction strengths previously noted between independent studies. It was observed, however, that the interaction strengths were approximately constant as a function of target nucleus at the incident energy of 37.5 MeV, whereas this constancy was not seen at lower energies. The poor description, both in shape and in strength, of the energy dependence of the data is evidence of basic inadequacies in the theories as they are presently used. On the basis of a simple shell-model, it is expected that the energy levels of excited states of the nucleus ^{46}V should be essentially the same as those for ^{50}Mn. This is because the two nuclei can be considered to be particle-hole conjugates. Particles and holes in a particular shell should be equivalent, according to the shell-model. To investigate this relationship, angular distributions were obtained for 16 levels in ^{46}V, ranging up to 4.01 MeV excitation, and 8 levels in ^{50}Mn, ranging up to 2.00 MeV excitation. The data were compared to both macroscopic and microscopic distorted-wave calculations, using a tensor force when appropriate. Several J, π assignments were made. The resulting level schemes for the two nuclei were compared with shell-model calculations. Significant discrepancies with the theory, and between the levels for the two nuclei, were noted. Presumably the experimental results now made available could aid in further theoretical refinements. The excited states of ^{50}Mn were also studied as a function of energy. Macroscopic asymmetry potential strengths and microscopic interaction strengths decreased significantly with energy, similar to the effect observed for the isobaric analog ground states. This points out the generality of the energy dependence of the strengths using the present theoretical methods. Values of the neutron excess deformation parameters, β_2 and β_4 were only mildly energy dependent for the energies examined in this study. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts: 46853, 46873, 46875, 46890, 46914, 46916, 46929, 46930, 46985, and 47066.

46931 NEUTRON DEFICIENT EVEN-EVEN ISOTOPES OF Kr, Se, Ge, AND PSEUDO SU_3 COUPLING. Nolte, E.; Kutschera, W.; Shida, Y.; Morinaga, H. (Technical Univ., Munich). Phys. Lett.; 33B: No. 4, 294-6(26 Oct 1970).

Gamma-ray spectra from the reactions ^{58,60,61,62,64}Ni(^{16}O, xn yp z$\alpha\gamma$) and ^{58}Ni(^{12}C, xn yp z$\alpha\gamma$) were studied and low-lying levels of neutron deficient even-even isotopes of Kr, Se and Ge were obtained. The results are compared with the recently proposed pseudo-LS and pseudo-SU_3 coupling schemes. (auth)

46932 LEVEL DENSITIES FROM SPECTRA OF DIFFERENT REACTIONS POPULATING THE SAME NUCLEUS. Lu, C. C.; Vaz, L. C.; Huizenga, J. R. (Univ. of Rochester, N. Y.). Nucl. Phys.; A190: No. 2, 229-60(1972).

Level densities of ^{56}Fe, ^{58}Co, ^{60}Ni, ^{62}Ni, ^{63}Cu and ^{65}Cu are determined from analyses of several charged-particle spectra populating the same residual nucleus. Experimental spectra are reported for the following reactions: ^{56}Fe(α,α')^{56}Fe, ^{59}Co(p,α')^{56}Fe, ^{59}Co(p,p')^{59}Co, ^{59}Co(α,α')^{59}Co, ^{56}Fe(α,p)^{59}Co, ^{62}Ni(p,α)^{59}Co, ^{60}Ni(α,α')^{60}Ni, ^{63}Cu(p,α)^{60}Ni, ^{62}Ni(p,p')^{62}Ni, ^{62}Ni(α,α')^{62}Ni, ^{59}Co(α,p)^{62}Ni, ^{65}Cu(p,α)^{62}Ni, ^{63}Cu(p,p')^{63}Cu, ^{63}Cu(α,α')^{63}Cu, ^{60}Ni(α,p)^{63}Cu, ^{65}Cu(p,p')^{65}Cu, ^{65}Cu(α,α')^{65}Cu and ^{62}Ni(α,p)^{65}Cu. Each of these experimental spectra is analyzed with an exact theory giving the angular and energy-dependent differential cross sections for compound-nucleus reactions including explicitly the angular momentum. From these analyses the Fermi-gas level-density parameters were determined: ^{56}Fe, a = 5.7 MeV^{-1}, Δ = 0.7 MeV; ^{59}Co, a = 6.2 MeV^{-1}, Δ = −0.8 MeV; ^{60}Ni, a = 6.4 MeV^{-1}, Δ = 1.3 MeV; ^{62}Ni, a = 6.4 MeV^{-1}, Δ = 0.5 MeV; ^{63}Cu, a = 6.8 MeV^{-1}, Δ = −0.5 MeV; and ^{65}Cu, a = 6.6 MeV^{-1} and Δ = −0.5 MeV. All of the spectra were also analyzed with the conventional slope technique which utilizes the Weisskopf expression for the differential cross sections. The results from such an analysis depend on the form of the pre-exponential term in the level-density formula and may give sizeable errors in the Fermi-gas level-density parameter a. A number of theoretical spectra are computed with the exact theory which explicitly includes angular momentum and these spectra are analyzed with the conventional methods to illustrate the errors introduced when angular momentum is not treated properly for such reactions. An estimate of precompound proton emission is made for several (p,p') reactions. (auth)

46933 INTENSITY RATIO OF 2158 keV AND 2505 keV GAMMA-RAYS IN THE DECAY OF ^{60}Co. Fujishiro, Masatoshi; Furuta, Junichiro (Radiation Center of Osaka Prefecture, Sakai, Japan). J. Nucl. Sci. Technol. (Tokyo); 9: No. 6, 348-52(Jun 1972).

The intensity ratio of the 2,158 and 2,505 keV γ-rays in the decay of ^{66}Co was measured by applying the photonuclear reactions ^{9}Be(γ,n) and ^{2}D(γ,n). The result obtained was an intensity ratio of {I(2,158)/I(2,505)} ~ 237, which exceeded all the values reported in available literature on previous measurements. (auth)

46934 (α,p) REACTION ON EVEN NICKEL ISOTOPES. Bucurescu, D.; Ivascu, M.; Semenescu, G.; Titirici, M. (Inst. of Atomic Physics, Bucharest). Nucl. Phys., A189: No. 3, 577-91(1972).

The (α,p) reaction on ^{58,60,62,64}Ni has been studied at an incident energy of 19.3 MeV. Zero-range DWBA calculations based on a triton-transfer mechanism describe well the whole set of experimental data. The strong J-dependence of the L = 1 transitions is described by using the spin-orbit coupling in the proton channel. The systematic behavior of the transitions for each L and J and the good agreement with the DWBA curves enable one to make spin assignments for levels in ^{67}Cu. The relative intensities of the ground state transitions agree with calculated values. The relative strengths for transitions to excited states are compared with those determined from proton-transfer reactions. (auth)

46935 DEPENDENCE OF THE DEORIENTATION OF NUCLEI OF RECOIL ATOMS (^{103}Rh AND ^{74}Ge) WHILE FREELY FLYING IN A VACUUM ON TIME. Ward, D.; Geiger, J. S.; Graham, R. L. (Chalk River Nuclear Labs., Ont.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2325-30(Nov 1971). (In Russian).

Nuclear spin alignment may be strongly disturbed in the absence of a decelerating medium. This type of deorientation was investigated using a plunger type of apparatus (Alexander and Bell, 1970), in which a beam of heavy ions impinged on a thin target of ^{74}Ge. Inelastic scattering of particles of the beam was recorded, as Coulomb excitation of the target atoms occurred. Similar measurements were made of the Coulomb excitation of the 295 keV $\frac{3}{2}^-$ level in ^{103}Rh. (K.S.W.)

46936 EXCITATION CROSS SECTION OF THE FIRST 2+ LEVELS OF Ni AND Zn NUCLEI DURING INELASTIC SCATTERING OF NEUTRONS IN THE NEAR-THRESHOLD ENERGY REGION. Konobeevskii, E. S.; Musaelyan, R. M.; Popov, V. I.; Surkova, I. V. (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2345-8(Nov 1971). (In Russian).

The energy dependence of the (n,nγ) reaction cross section with excitation of the first 2+ levels of ^{58,60}Ni and ^{64,66,68}Zn was investigated. The experimental data for Ni is satisfactorily described by the optical model without allowing for the correlation of the resonance widths. The cross section for Zn exceeded the calculated value. (tr-auth)

46937 EXCITATION OF INPUT STATES DURING THERMAL NEUTRON CAPTURE BY ^{68}Zn, ^{70}Ge, AND ^{80}Se. Murzin, A. V.; Kolomiets, V. M. (Inst. of Nuclear Research, Kiev). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2349-54(Nov 1971). (In Russian).

Possible types of input states were examined which were excited during capture of thermal neutrons by ^{68}Zn, ^{70}Ge, and ^{80}Se nuclei. Special features of the γ spectra of capture are explained qualitatively for the isotopes ^{69}Zn, ^{71}Ge, and ^{81}Se, and their low excited levels are depicted schematically. (tr-auth)

46938 DECAY OF ^{76}Br. Dzhelepov, B. S.; Dmitriev, A. G.; Zhukovskii, N. N. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2249-54(Nov 1971). (In Russian).

Two β^+ components were derived from the ^{76}Br spectrum: 3,980 and 3,440 keV. The ratio of their intensities was 0.22. The ratio of the intensities of the transitions γ 559 and β^+ 3,980 was 7.6. Six new lines were detected in the ^{76}Br γ spectrum; their relative intensities were measured. The energy values and relative intensities of the ^{76}As γ lines were also determined. The decay scheme of ^{76}Br was refined. High values for log ft of the β^+-transitions on the basis of the excited states (ground, 0^+, and first-excited, 2^+) of ^{76}Se are evidence of $J^\pi = 1^-$ for the ground state of ^{76}Br. (tr-auth)

46939 IZOBARNYE YADRA S MASSOVYM CHISOLM A = 72. (Isobaric Nuclei with Mass Number A = 72). Vitman, V. D.; Dzhelepov, B. S.; Medvedev, A. I. Svoistva Atomnykh Yader, Vypusk 13. Leningrad; Izdatel'stvo Nauka Leningradskoe Otdelenie (1972). 120p.

This monograph summarizes the voluminous material on the nuclei ^{72}Zn, ^{72}Ga, ^{72}Ge, ^{72}As, ^{72}Se, ^{72}Br, and ^{72}Kr which has appeared in print up to September 1, 1971. The information compiled includes energies and intensities of radioactive emissions from these isotopes, detailed decay schemes, quantum characteristics of excited levels, and similar properties. The reliability of the data is evaluated, and additional investigation is recommended for certain work. (tr-auth)

46940 NUCLEAR γ RAYS ASSOCIATED WITH STOPPED KAONS. Barnes, P. D. (Carnegie-Mellon Univ., Pittsburgh); Eisenstein, R. A.; Lam, W. C.; (and others). Phys. Rev. Lett.; 29: No. 4, 230-3(24 Jul 1972).

A large number of nuclear γ rays associated with negative kaons stopped in Ni, Cu, Si, and Al were identified. Prominent among these for both the Cu and the Ni targets are transitions that take place in even–even nuclei lighter than the target by up to about twelve nucleons. In both cases, the total intensity of all of the identified nuclear γ rays amounts to about twice that of the strongest x ray. (auth)

46941 SEARCH FOR THE REACTION $\mu^- + Cu \rightarrow e^+ + Co$. Bryman, Douglas Andrew. Blacksburg, Va.; Virginia Polytechnic Inst. and State Univ. (1972). 62p. University Microfilms Order No. 72-18,005.

Thesis.

A search was performed for the reaction $\mu^- + Cu \rightarrow e^+ + Co$, which is allowed by the lepton conservation scheme that assigns the same lepton number to the μ^-, e^+, ν_μ, and $\bar{\nu}_e$. Momentum analysis of particles emitted following muon capture was performed using a magnetic spectrometer with magnetostrictive readout wire spark chambers. The time of flight through the spectrometer and energy loss in a scintillation counter were measured for each event. One event was observed, at momentum 89.9 ± 3.5 MeV/c, which is consistent with the above process. Background from radiative muon capture was expected to produce ≃0.01 events that could stimulate the search for reaction. However, there exists uncertainty in the relative yield and cutoff for high energy photons from radiative muon capture. Although it is not certain whether or not the reaction $\mu^- + Cu \rightarrow e^+ + Co$ has been detected, an upper limit was set on the branching ratio relative to ordinary muon capture of $R \leq 2.6 \times 10^{-8}$ (90% confidence level). According to a calculation by Kisslinger, this can be related to an upper limit on the coupling constant of this type of interaction relative to the vector coupling constant of $(G_\Delta/G_V) \leq 0.10^{+0.05}_{-0.06}$. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts: 46873, 46875, 46883, 46889, 46890, 46909, 46911, 46916, 46917, 46930, 46935, 47066, 47072, 47073, 47075, and 47209.

46942 (JINR–P6-6512) STUDY OF THE DECAY ^{148}Tb($T_{½}$ = 66 min) AND ^{150}Tb($T_{½}$ = 3.48 ± 0.16 h). Vylov, Ts.; Gromov, K. Ya.; Gromova, I. I.; Iskhakov, G. I.; Kuznetsov, V. V.; Kuznetsova, M. Ya.; Potempa, A. V.; Fominykh, M. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 28p. (In Russian). Dep. NTIS (U. S. Sales Only).

Gamma-ray, conversion electron, and γ–γ coincidence spectra in the decay of ^{148}Tb and ^{150}Tb were studied. The half-life was measured for ^{150}Tb ($T_{½}$ = 3.48 ± 0.16 h). The decay schemes ^{148}Tb → ^{148}Gd and ^{150}Tb → ^{150}Gd are proposed. The comparison is made for the excited states of neighboring nuclei ^{148}Gd, ^{146}Sm, ^{144}Nd and ^{150}Gd, ^{148}Sm, ^{146}Nd. (auth)

46943 (N–72-18705) PARTICLE–HOLE STATES IN ^{120}Sn. Leonard, Regis F. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). 31 Jan 1972. 9p. (CONF-720119–1; NASA-TM-X–68004; E–6772). NTIS.

From American Physical Society meeting; San Francisco, CA. (31 Jan 1972).

The 45 MeV deuteron beam from the Berkeley 88-inch cyclotron was used to study the particle-hole states in ^{120}Sn. The present work resolved a number of individual levels and compared their strength and excitation energy with that observed in the Sn-102(d,He-3) reaction, which was also remeasured. A schematic diagram of the scattering system is given along with a description. (auth) (STAR)

46944 DECAY OF ISOMERS $^{128\ 128\ 130}$Sb AND QUASIPARTICLE LEVELS $^{128\ 128\ 130}$Te WITH LARGE SPIN. Kiselev, V. G.; Levkovskii, V. N.; Artem'ev, O. I.; Peker, L. K. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2300-5(Nov 1971). (In Russian).

The gamma spectra of ^{128,128,130}Sb were measured, and the resulting data were utilized in the construction of a decay scheme.

Analysis of the data showed two-particle levels with $I^\pi = 7-$ and four particle levels with $I^\pi = 9-$ for the isotopes ^{126,128,130}Te. (tr-auth)

46945 ^{135}Ba LEVELS. Begzhanov, R. B.; Glad'shev, D. A.; Kobilov, O. Sh.; Radzhapov, P. S.; Sabirov, Kh. S. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2312-15(Nov 1971). (In Russian).

The angular correlations (γ 373), (γ 481) and (γ 633), (γ218) were measured in the ^{135}Ba nucleus. Spin and parity of $1/2^+$, $5/2^+$, and $3/2^+$ are uniquely described by the levels 218, 481, and 852 keV, respectively. The lifetime of the 481 keV level was evaluated by delayed $\gamma\gamma$ coincidence: $T_{\frac{1}{2}} \leq 10$ psec. (tr-auth)

46946 NEUTRON SPECTROMETRY OF THE Sb NUCLEUS. Mateiciuc, V. A. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 24: No. 2, 165-97(1972). (In Rumanian).

A pulsed neutron source and a time-of-flight spectrometer were used to study neutron reactions with Sb. Measured quantities included the Sb neutron cross section at 0.05 to 150 eV, radiative capture widths, reduced neutron widths, average level spacings, the neutron strength function, Doppler effect and crystal binding effect on neutron resonances, and ^{121}Sb resonance parameters. The experimental facilities and equipment are described. (J.W.R.)

46947 DETERMINATION OF THE TOTAL COEFFICIENT OF INTERNAL GAMMA-RADIATION CONVERSION OF ^{139}La. Aristov, E. A.; Bazhenov, V. A. Meas. Tech. (USSR) (Engl. Transl.); 14: No. 12, 1883-5(Dec 1971).

Translated from Izmer. Tekh.; 14: No. 12, 61-2(Dec 1971).

The decay of ^{139}Ce was studied using a proportional counter–NaI(Tl) scintillation detector coincidence setup. Measurements were made on γ–x-ray coincidences for six carefully prepared sources. The results were used to determine the total internal conversion coefficient for the 166-keV transition in ^{139}La. (J.W.R.)

46948 ^{132}Ba LEVELS EXCITED DURING THE DECAY OF ^{132}La AND ^{132*}La. Amov, B.; Bylov, Ts.; Enikova, M.; (and others). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2266-71(Nov 1971). (In Russian).

The isotope ^{132}La was obtained by irradiating a gadolinium target with 660 MeV protons in a synchrotron. Gamma spectra, electron conversion spectra, and $\gamma\gamma$ coincidence were studied. A decay scheme was constructed for excited levels of ^{132}Ba, and the intensities of some γ-transitions which arose during the decay of ^{132}La and ^{132*}La were measured. (K.S.W.)

46949 ISOMERIC TRANSITION $8^- \rightarrow 6^+$ IN THE ^{130}Ba NUCLEUS. Arsen'ev, D. A.; Dzholos, R. V. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2281-6(Nov 1971). (In Russian).

A model was proposed for describing the properties of a transient nucleus, based on energy calculations of the deformation of a nucleus. Using this model the isomeric state 8^- in the ^{130}Ba nucleus was studied. (tr-auth)

46950 OPTICAL DETERMINATION OF THE QUADRUPOLE MOMENT OF ^{138}La. Fischer, W. (Univ., Marburg, Ger.); Huehnermann, H.; Mandrek, K.; Ihle, H. Phys. Lett.; 40B: No. 1, 87-8(12 Jun 1972).

The rare lanthanum isotope ^{138}La was highly enriched with the aid of an electromagnetic isotope separator. The hyperfine structure of two La lines was investigated by means of optical interference spectroscopy, which allowed the determination of the nuclear electric quadrupole moment $Q(^{138}La) = 0.51 \pm 0.09$ b. (auth)

46951 EXCITATION OF THE ^{99}Tc NUCLEUS. Begzhanov, R. B.; Sabirov, Kh. S. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2316-22(Nov 1971). (In Russian).

The $\gamma\gamma$-angular correlation of cascades 740-180 and 740-40-140 keV in ^{99}Tc was investigated. The lifetimes of the 922 and 180 keV states were measured ($T_{\frac{1}{2}} = 0.2 \times 10^{-9}$ sec and 3.36×10^{-9} sec, respectively). Conclusions were drawn regarding the quantum characteristics of several levels. (tr-auth)

46952 SUB-BARRIER (p,n) REACTION IN THE REGION OF SINGLE-PARTICLE RESONANCE. Sirotkin, V. K.; Chesnokova, V. D. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2359-63(Nov 1971). (In Russian).

The energy dependence of a sub-barrier (p,n) reaction of Sn isotopes in the region of single-particle 3p-resonance was analyzed on the basis of the shell approach to the theory of nuclear reactions. A significant difference in the results of the shell approach and of the optical model was detected. The results of numerical calculations were compared with experimental data. (tr-auth)

46953 CONVERSION OF BREMSSTRAHLUNG PHOTO NEUTRON MEAN ENERGIES TO MONOCHROMATIC PHOTO NEUTRON MEAN ENERGIES. Thies, H. H.; Thomas, B. W.; Lee, F.; Kochi, R.; Crawford, D. M. (Univ. of Western Australia, Nedlands). Nucl. Instrum. Methods; 102: No. 2, 219-22(1972).

Using a method described by Barrett and Thies one can measure readily the mean energies of neutrons produced in bremsstrahlung experiments. It is shown here how one can calculate from data on bremsstrahlung photo neutron mean energies the neutron mean energies that correspond to an idealized experiment using monochromatic gammas. Simple formulae are derived to estimate the accuracy of calculated mean energies. The practical limits of experiments on photo neutron mean energies are discussed. (auth)

46954 MULTIPOLE ORDER OF TRANSITIONS AND CHARACTERISTICS OF THE EXCITED STATE OF ^{147}Eu BY THE METHOD OF ANGULAR $\gamma\gamma$ CORRELATION. Vyvryshchuk, Ya.; Zhuk, V.; Krupa, E.; (and others). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2331-4(Nov 1971). (In Russian).

Measurements of the angular correlation of γ quanta with energies of 396, 765, 893, and 1,130 keV were made, coincident with the most intense γ transition of 229 keV in ^{147}Eu. For the 1,359 keV level, $I^\pi = 9/2$, and for the 1,122.3 keV level the most probable value of $I^\pi = 5/2^+$. (tr-auth)

46955 HINDERED $7/2^+ \rightarrow 3/2^-$ β-DECAY OF ^{143}Pr. Griffin, H. C. (Univ. of Michigan, Ann Arbor); Rengan, K. Nucl. Phys.; A190: No. 2, 293-6(1972).

A low-intensity 742 keV γ-ray has been found in the decay of 13.6 d ^{143}Pr. This γ-ray is interpreted as evidence for a weak β-transition (1.2×10^{-6}%, log f_0t = 13.2, log f_1t = 11.6) from ^{143}Pr ($J^\pi = 7/2^+$) to the 742 keV first excited state of ^{143}Nd ($3/2^-$). (auth)

46956 ^{90}Zr(d,n)^{91}Nb AND ^{96}Zr(d,n)^{97}Nb REACTIONS. Horton, J. L. (Univ. of Texas, Austin); Hollas, C. L.; Riley, P. J.; (and others). Nucl. Phys.; A190: No. 2, 362-72(1972).

The (d,n) reaction on ^{90}Zr and ^{96}Zr has been studied at 12 MeV deuteron bombarding energy using the neutron time-of-flight technique with an overall neutron time resolution of 1.9 ns. Angular distributions of neutron groups leading to states in ^{91}Nb and ^{97}Nb were measured in the angular range between 15° and 60°. The measured cross sections were analyzed in the framework of the distorted-wave theory of stripping reactions to deduce l-values and proton spectroscopic factors of states in the residual nuclei. The results are compared with the corresponding data available from (^{3}He,d) studies. The fractionation of the single-particle proton states and their centroid energies are determined. (auth)

46957 GAMMA–GAMMA ANGULAR CORRELATION OF THE 171- TO 427-keV CASCADE AND THE g-FACTOR OF THE 462-keV, $5/2^+$ LEVEL OF ^{125}Te. Nigam, A. K.; Bhattacharyya, R. (Saha Inst. of Nuclear Physics, Calcutta). Indian J. Phys.; 45: No. 5, 214-24(May 1971).

The gyromagnetic ratio of the 462 keV $5/2^+$ state in ^{125}Te has been measured by IRF method using perturbed angular correlation technique and the g-factor value obtained as $g = -0.56 \pm 0.70$. The angular correlation coefficients of the 171–427 keV cascade, used in the g-factor measurement of the 462 keV state, have also been measured. The magnetic moment of the 462 keV, $5/2^+$ level is computed on the basis of Kisslinger–Sorensen model. (auth)

46958 GYROMAGNETIC RATIO OF THE 2083-keV, 4^+ STATE OF ^{140}Ce. Nigam, A. K.; Bhattacharyya, R. (Saha Inst. of Nuclear Physics, Calcutta). Indian J. Phys.; 45: No. 5, 225-9(May 1971).

The g-factor of the 2083 keV level ($T_{\frac{1}{2}} = 3.41$ ns) of ^{140}Ce was measured using differential perturbed angular correlation method at a magnetic field of about 19 kilo-oersteds. The measurements were performed using $\gamma_1-\gamma_2$ and $\gamma_1-\gamma_3$ radiation cascades of the 329-487-1596 keV triple cascade, separately. The values of the g-factor obtained by both measurements are in good agreement. The average value of the g-factor comes out to be $g = 1.16 \pm 0.08$. Besides this, the angular correlation measurements using $\gamma_1-\gamma_2$ and $\gamma_1-\gamma_3$ cascades were also performed. A differential angular correlation measurement, however, determined the attenuation of the angular correlation coefficients. (auth)

46959 MAGNETIC MOMENT OF THE 2761 keV 8^+ STATE IN ^{92}Mo. Cochavi, S.; McDonald, J. M.; Fossan, D. B. (State Univ. of New York, Stony Brook). Phys. Lett.; 33B: No. 4, 297-8(26 Oct 1970).

The g-factor for the 2761 keV 8^+ state in ^{92}Mo has been measured by a time-differential technique with the ^{90}Zr(α,2n)^{92}Mo reaction. The result is $g = 1.40 \pm 0.07$ ($\mu = 11.2 \pm 0.6$ nm) which

is consistent with a pure $|(1g_{9/2})^2, 8^+\rangle$ wave function. Evidence for an enhanced g_1 is discussed. (auth)

46960 MEASUREMENT OF THE QUADRUPOLE MOMENT OF A SHAPE ISOMER. Gerschel, C.; Perrin, N.; Valentin, L. (Institut de Physique Nucleaire, Orsay, France). Phys. Lett.; 33B: No. 4, 299-301(26 Oct 1970). (In French).

A perturbed differential angular correlation measurement on lanthanum magnesium double nitrate yields the quadrupole moment Q = 1.6 ± 0.2 b, and the deformation $\beta = 0.47$ for the 535 keV level of ^{133}La. Discussion of these values and that of the magnetic moment confirms the existence of shape isomerism. (auth)

46961 COULOMB EXCITATION OF ^{117,119}Sn. Stelson, P. H.; Milner, W. T.; McGowan, F. K.; Robinson, R. L.; Raman, S. (Oak Ridge National Lab., Tenn.). Nucl. Phys.; A190: No. 2, 197-217(1972).

A total of 5 states in ^{117}Sn and 4 states in ^{119}Sn were observed to be Coulomb excited with α-particle and ^{16}O projectiles. Level energies, spins, B(E2) and B(M1) transition probabilities and mean-lives were obtained. For ^{117}Sn, spin $3/2^+$ states were observed at 158.7 and 1005 keV and spin $5/2^+$ states were observed at 1020, 1180 and 1447 keV. For ^{119}Sn, spin $3/2^+$ states were observed at 23.9 and 920.5 keV and spin $5/2^+$ states were observed at 921.4, 1090 and 1354 keV. A total of 20 B(E2) values were obtained and they varied in magnitude from $1/10$ to 10 times the single-particle estimate. About 12 B(M1) values were obtained and they range from 10^{-1} to 10^{-4} of the single-particle estimate. Evidence was found for the existence of quadrupole collective states built on low-lying excited quasiparticle states. (auth)

46962 POSSIBLE EVIDENCE FOR A CONTRIBUTION FROM DIRECT COLLISIONS IN K-SHELL INTERNAL IONIZATION ACCOMPANYING β DECAY. Isozumi, Y.; Mukoyama, T.; Shimizu, S. (Kyoto Univ.). Phys. Rev. Lett.; 29: No. 5, 298-301(31 Jul 1972).

Rigorous calculations of the energy-dependent K-shell internal ionization probability were performed by using an improved one-step theory of electron shakeoff. The measured probability for ^{147}Pm considerably exceeds the theoretical curve at low electron energies. This suggests that the direct collision process may play an important role when both a β particle and a K electron are emitted with low kinetic energies. (auth)

46963 GAMMA GAMMA DIRECTIONAL CORRELATION MEASUREMENTS IN ^{131}Cs. Sturm, R.; Theile, F. W.; Thielmann, R.; Gruenberg, E. (Univ., Marburg, Ger.). Z. Phys.; 252: No. 4, 312-23(1972). (In German).

^{131}Cs decay was studied by angular correlation measurements of the (404-216), (832-216), and (247-373) keV γ cascades using NaI(Tl) detectors in connection with a two-parameter multichannel analyzer. Unique spin assignments were obtained for the 216 ($J^\pi = 3/2^+$) and 373 ($J^\pi = 3/2^+$) keV levels. A previously discussed value of $J^\pi = 5/2^+$ for the 1048-keV level was ruled out. The multipole character of the 404-keV transition was found to be E2 with less than 2% M1. (2 figures, 2 tables) (auth)

46964 LOW-LYING STATES AND CONFIGURATIONS IN ^{138}La. Lasijo, Romedon (Florida State Univ., Tallahassee); Sheline, Raymond K.; Griffioen, Roger D.; DuBard, James L. Z. Phys.; 253: No. 1, 17-27(1972).

Tritons from the reaction ^{139}La(d,t)^{138}La at $E_d = 16$ MeV were analyzed at eleven reaction angles from 22° to 90° with a broad-range magnetic spectrograph. The Q value of the reaction is −2522 ± 5 keV. The nine lowest-lying states in ^{138}La are interpreted in terms of the shell-model configurations $(\pi g_{9/2})^{-1}(\nu d_{5/2})^{-1}$, $(\pi g_{9/2})^{-1}(\nu s_{1/2})^{-1}$, and $(\pi g_{9/2})^{-2}(\pi d_{5/2})^1(\nu d_{5/2})^{-1}$. Seven levels in the energy range of 700 to 1300 keV are populated by l = 5 transitions and are interpreted as coming from the $(\pi g_{9/2})^{-1}(\nu h_{11/2})^{-1}$ configuration. The ground state of ^{138}La is shown to have $J^\pi = 5^+$; therefore, beta decay by unique, second-forbidden transitions to the 2^+ one-phonon states of ^{138}Ce and ^{138}Ba must be inferred in spite of the unusually high log-ft values of 19.2 and 18.5, respectively. (5 figures, 2 tables) (auth)

46965 COLLECTIVE STATES OF EVEN-EVEN NUCLEI OF Mo AND Ru INCLUDING UNPAIRED NUCLEONS. Peker, L. K. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2390-2 (Nov 1971). (In Russian).

In even-even nuclei, collective states, including unpaired nucleons, should possess considerable energy and therefore are located in the region of spectra with a large density of levels. It is shown that in even-even Mo and Ru nuclei there are manifest collective levels, including unpaired nucleons. (K.S.W.)

46966 EXPERIMENTAL NEUTRON RESONANCE SPECTROSCOPY. Harvey, J. A. (ed.). New York; Academic Press, Inc. (1970). 544p. $29.50.

Separate abstracts were prepared for each of the five chapters in this book. (R.W.R.)

For abstracts of individual chapters see: 45641, 46967–46969, and 47036.

46967 TOTAL NEUTRON CROSS SECTION MEASUREMENTS. Firk, F. W. K. (Yale Univ., New Haven); Melkonian, E. pp 101-54 of Experimental Neutron Resonance Spectroscopy. /Harvey, J. A. (ed.). New York; Academic Press, Inc. (1970).

A brief introduction is followed by sections on experimental techniques, analysis of neutron spectrometer transmission data, the self indication method, and data obtained from total cross section measurements. An extensive list of references is included. (J.W.R.)

46968 NEUTRON SCATTERING AND CAPTURE CROSS-SECTION MEASUREMENTS. Rae, Ernest R. (Atomic Energy Research Establishment, Harwell, Eng.); Block, Robert C. pp 155-233 of Experimental Neutron Resonance Spectroscopy. /Harvey, J. A. (ed.). New York; Academic Press, Inc. (1970).

Measurements in the resonance region, including determination of partial widths and spins, and average cross section measurements are discussed in the introduction. General considerations and experimental measurements on neutron capture and scattering are discussed. Shell transmission and activation measurements on neutron capture are covered. Some results are reviewed. An extensive list of references is included. (J.W.R.)

46969 GAMMA RAYS FROM NEUTRON CAPTURE IN RESONANCES. Bollinger, Lowell M. (Argonne National Lab., Ill.). pp 235-345 of Experimental Neutron Resonance Spectroscopy. /Harvey, J. A. (ed.). New York; Academic Press, Inc. (1970).

Sections are included on general characteristics of the spectra, apparatus, analysis of spectra, and experimental results. An extensive list of references is also included. (J.W.R.)

46970 LOG-f TABLES FOR BETA DECAY. Gove, N. B.; Martin, M. J. (Oak Ridge National Lab., Tenn.). Nucl. Data, Sect. A; 10: No. 3, 205-317(Nov 1971).

An extensive tabulation of log-f values is presented for use in the calculation of the comparative half-lives for beta transitions. Values of capture-to-positron ratios are also given. These log-f- and ϵ/β^+- values incorporate screening and finite nuclear size corrections. They are tabulated for allowed and first-forbidden unique transitions for Z from 6 to 95 as a function of transition energy. The range of transition energies covered is 0.010 MeV to 10 MeV with energy increments chosen so that intermediate values can be obtained from the tables by means of linear extrapolation. The values for first-forbidden unique transitions are larger than those given in older tables by 1.079, the log of 12. (auth)

46971 DIRECT MEASUREMENT OF gamma-RAY ENERGIES AND HALF-LIFE OF ^{141}Cs SEPARATED BY PAPER ELECTROPHORESIS. Tamai, Tadaharu; Takada, Jitsuya; Matsushita, Rokuji; Kiso, Yoshiyuki (Kyoto Univ.). J. Nucl. Sci. Technol. (Tokyo); 9: No. 6, 378-80(Jun 1972).

Cesium-141 was separated from fission products using paper electrophoresis. The γ spectra from the decay of ^{141}Cs were studied using a Ge(Li) detector and a multichannel analyzer. The observed γ energies and intensities were compared with previous data. A half-life of 25 sec was determined. (J.W.R.)

46972 GAMMA RAY SPECTROSCOPIC STUDIES OF MEMBERS OF THE A = 141 DECAY CHAIN. Todd, Richard Ross. East Lansing, Mich.; Michigan State Univ. (1971). 199p. University Microfilms Order No. 72-16,527.

Thesis.

The techniques of beta and gamma ray spectroscopy have been applied to a study of the decay schemes of ^{141m,g}Sm and ^{141}Pm. The goal of this study was to increase our understanding of nuclear structure and to obtain information about energy level systematics in these members of the A = 141 decay chain below the N = 82 closed shell. Ge(Li) singles, Ge(Li)-Ge(Li) two parameter coincidence and Ge(Li)-NaI(Tl) (anti) coincidence spectrometers were used to identify and establish the sequence of gamma ray transitions. The decay schemes were determined and comparisons are made with previous studies as well as the results of recent reaction work. Forty-seven transitions have been identified with the beta decay of ^{141m}Sm and 40 of these have been incorporated in a decay scheme involving 16 levels in the daughter ^{141}Pm. These levels are at 0, 196.6, 628.6, 804.5, 837.1, 974.0, 1108.1, 1167.2, 1313.2, 1414.8, 1834.0, 1983.1, 2063.5, 2091.6, 2119.0, and 2702.4 keV. The lifetime of the state at 628.6 keV in ^{141}Pm was measured to be 700 ± 20 ns and the E3 transition from this level to the ground state was found to exhibit an enhancement of 1.6 spu. The decay of ^{141g}Sm was observed to populate levels at

403.9, 438.4, 728.0, 1292.7, 1495.7, 2004.5, and 2037.7 keV in ^{141}Pm. Of the 50 transitions observed in the decay of ^{141}Pm, 43 of these have been placed in a level scheme containing 23 levels. The levels identified are at 0, 193.8, 1223.3, 1345.8, 1564.8, 1596.8, 1820.4, 1897.1, 1968.0, 2066.4, 2073.7, 2109.6, 2145.2, 2246.6, 2265.3, 2303.4, 2354.4, 2388.4, 2430, 2506, 2620, 2805, and 2986 keV. Limits on the possible spin assignments of the levels identified have been made from calculated log ft values and observation of transitions to levels of known spins. A three-quasiparticle multiplet of high-spin, odd parity states was identified between 1.4 and 2.7 MeV in ^{141}Pm. The decay characteristics of the multiplet suggest the possibility of obtaining information about its structure from shell model calculations using a limited basis. A survey has been made of the energy level systematics and properties of low-lying states in the N = 80, 81, and 82 odd mass isotones. These observations have led to some predictions and suggestions for future experiments. (Diss. Abstr. Int., B)

46973 ISOTOPE SHIFT STUDIES IN THE RARE EARTHS AND LEAD. Lee, Paul Lung Sang. Pasadena, Calif.; California Inst. of Tech. (1972). 88p. University Microfilms Order No. 72-17,644.

Thesis.

Isotope shifts of $K_{\alpha 1}$ x-ray transitions were measured for the Neodymium isotopes Nd 142, 143, 144, 145, 146, 148 and 150, the Samarium isotopes Sm 147, 148, 149, 150, 152 and 154, the Gadolinium isotopes Gd 154, 155, 156, 157, 158 and 160, the Dysprosium isotopes Dy 162 and 164, the Erbium isotopes Er 166, 168 and 170, the Hafnium isotopes Hf 178 and 180 and the Lead isotopes Pb 204, 206, 207 and 208. A curved crystal Cauchois spectrometer was used. The analysis of the measurement furnished the variation of the mean square charge radius of the nucleus, $\delta \langle r^2 \rangle$, for 23 isotope pairs. The experimental results were compared with theoretical values from nuclear models. Combining the x-ray shifts and the optical shifts in Nd and Sm yielded the optical mass shifts. An anomaly was observed in the odd-even shifts when the optical and the x-ray shifts were plotted against each other. (Diss. Abstr. Int., B)

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Refer also to abstracts: 46149, 46875, 46916, 46953, 46962, 46973, 47008, and 47066.

46974 (FRNC-TH-207) DE-EXCITATION OF THE COMPOUND NUCLEI FORMED IN ^{181}Ta + ^{11} ^{10}B REACTIONS. Delagrange, Hugues (Bordeaux Univ. (France)). 1972. 87p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

Twelve isotopes were identified after the irradiation of thick-recoil thick type stacks of Ta targets with ^{10}B and ^{11}B ions having energies in the 10 MeV per nucleon range. Very complicated spectra were obtained from nonchemically treated targets using high resolution α analysis equipment. Statistical analysis techniques were used to resolve the decay curves and to accurately determine the efficiency of the Ge(Li) junction used. The production cross sections and the mean paths of eight of the isotopes were measured. The form of the excitation functions and the variation of the mean path with energy demonstrate that ^{188}Pt, ^{186}Ir and ^{185}Os result from the formation of the compound nucleus. Calculation of the production cross sections made for these three isotopes, using the statistical evaporation model, explain the experimental results, the two principal parameters being the moment of inertia of the nuclei and the γ transition strength parameters. The magnitude of the energy carried off by the first neutrons confirms the existence of γ emission at the end of the evaporation chain. (France)

46975 (JINR-P4-6462) ON PARAMETRIZATION OF B(E2)-TRANSITION IN DEFORMED EVEN-EVEN NUCLEI WITHIN THE SU(3) SCHEME. Raichev, P. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 18p. (In Russian). Dep. NTIS (U. S. Sales Only).

A problem is discussed concerning possible applications of the SU(3) scheme to deformed even–even nuclei. The transition probabilities are parametrized using the free parameters arising in the SU(3) scheme. The results obtained are compared with experimental data. (3 figures, 1 table) (auth)

46976 (JINR-P6-6492) STUDY OF THE ^{179}Re DECAY. THREE-QUASIPARTICLE STATES IN ^{179}W. Arl't, R.; Bayar, B.; Vylov, Ts.; (and others) (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 20p. (In Russian). Dep. NTIS (U. S. Sales Only).

The decay scheme of ^{179}Re has been studied. The following rotational bands in the decay of ^{179}Re were identified: $7/2^-$ (514), $1/2^-$ (512), $3/2^+$ (624), $5/2^-$ (512), $7/2^+$ (633) and three-quasiparticle states: $3/2^+$ [$5/2^-$ (514), $5/2^+$ (402), $1/2^-$ (514)] and $7/2^+$ [$9/2^-$ (514), $5/2^+$ (402), $7/2^-$ (514)]. (auth)

46977 NEW ISOTOPES OF IRIDIUM. Nadzhakov, E.; Bochev, B.; Venkova, Ts.; (and others). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2202-6(Nov 1971). (In Russian).

In the irradiation of Ho by the ions ^{22}Ne and ^{20}Ne there are obtained highly-neutron-deficient isotopes of iridium. They were identified by means of their genetic association with daughter isotopes of osmium and rhenium. The new isotopes discovered were ^{181}Ir (10 ± 2 min), ^{180}Ir (6.5 ± 1.5 min), and ^{179}Ir (4 ± 1 min). (tr-auth)

46978 ELECTRON CONVERSION SPECTRUM OF ^{182}Re. Gavrilyuk, V. I.; Kupryashkin, V. T.; Latyshev, G. D.; (and others). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2232-48(Nov 1971). (In Russian).

The electron conversion spectrum of isomers of ^{182}Re with $T_{1/2}$ = 12.7 hr and 64 hr was investigated with a resolution of 0.03 to 0.04% with respect to H/ρ. Many unknown transitions were discovered. The internal conversion ratio and the multipole order of the majority of γ transitions were determined. A mixture of multipole orders was established according to the ratios of intensities of conversion lines in the L- and M-subshells. The decay scheme was constructed. (tr-auth)

46979 ^{175}Hf STATES EXCITED DURING THE DECAY OF ^{175}Ta. Gadzhokov, V.; Zvol'ski, I.; Molnar, I.; Nenov, N. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2255-65(Nov 1971). (In Russian).

The excited levels of ^{175}Hf which arose from the decay of ^{175}Ta were studied, and the electron conversion spectrum, γ rays, and $\gamma\gamma$-coincidence were evaluated. On the basis of experimental data a decay scheme for the process ^{175}Ta → ^{175}Hf is proposed with 23 new levels. (tr-auth)

46980 ROTATIONAL LEVELS WITH HIGH SPINS IN ^{171}Lu. Barneoud, D.; Foin, C.; Baudry, A.; (and others) (Univ., Grenoble, France). J. Phys. (Paris); 33: No. 1, 15-22(Jan 1972). (In French).

Energies and intensities of the gamma-rays following ^{169}Tm $(\alpha,2n)^{171}$Lu reaction were measured with Ge(Li) detectors. Rotational bands involving the $7/2^+$ [404] (ground state) $1/2^-$[541], $1/2^+$[411], $5/2^+$[402], $9/2^-$[514] intrinsic states were identified using the two-dimensional $\gamma-\gamma$ coincidence technique and analyzed with classical methods. The large perturbations observed for $1/2^-$[541] band are studied in terms of a Coriolis mixing in the $3/2^-$[532] band. The best fit is obtained when the energy of the $3/2^-$[532] band head is comprised between 600 and 700 keV. A tentative identification of this state at 674 keV is suggested. (France)

46981 MAGNETIC PROPERTIES OF ^{153}Eu, ^{155}Eu, AND ^{189}Os. Begzhanov, R. B.; Gaffarov, D. G.; Muminov, A. I.; Radzhapov, P. S. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2295-9(Nov 1971). (In Russian).

The half-lives of the levels 69, 95, and 219 keV of the ^{189}Os nucleus: (2.12 ± 0.10), ≤0.3 and ≤0.3 nsec, were measured using a delayed $\gamma\gamma$ coincidence method. The angular correlation of six cascades of γ radiation from the ^{189}Os nucleus was investigated. The g-factors of the excited states 103.2 keV for ^{153}Eu, 105 keV for ^{155}Eu, and 69 and 95 keV for ^{189}Os were measured. (tr-auth)

46982 PARITY NONCONSERVING EFFECTS IN NUCLEI ^{175}Lu AND ^{181}Ta. Grabowski, J. (Inst. of Nuclear Physics, Krakow). Phys. Lett.; 33B: No. 4, 268-70(26 Oct 1970).

The nuclear part R of the parity nonconserving circular polarization in 343 keV and 396 keV gamma transitions in ^{175}Lu and 482 keV gamma transition in ^{181}Ta have been calculated. (auth)

46983 STRUCTURE OF GROUND STATES OF ODD–ODD NUCLEI ^{160}Tb, ^{182}Ta, ^{182}Re, AND OF ISOMER ^{182m}Re. Galan, P. (Inst. of Physics, Bratislava). Czech. J. Phys.; 22: No. 6, 468-75(1972).

The ground states of the odd–odd nuclei ^{160}Tb, ^{182}Ta, and ^{182}Re and the isomeric state ^{182m}Re are interpreted in terms of the Nilsson nuclear model. The conclusions about the structure of these states were drawn from the experimental results obtained in the study of their decay to the neighboring even–even nuclei as well as from the systematics of single-particle proton and neutron states in neighboring odd-mass nuclei. The agreement between experimental and calculated values of the moments of inertia of these states is demonstrated. (auth)

46984 LEVEL STRUCTURE OF ^{187}Os FROM THE DECAY OF ^{187}Ir. Ahlgren, Karin; Daly, P. J. (Purdue Univ., Lafayette, Ind.). Nucl. Phys.; A189: No. 2, 368-84(1972).

The decay of ^{187}Ir was investigated using Ge(Li) detectors in singles and coincidence γ-ray measurements. While the measured γ-ray energies and intensities were in good agreement with the values obtained in a recent study, the coincidence results were invaluable in correctly placing all the strong transitions and in establishing an extensive ^{187}Os level spectrum accommodating more than 98% of the decay intensity. An interpretation of the ^{187}Os level structure in terms of the Nilsson model is presented which includes assignments of levels in the 500 to 1000 keV excitation energy range to the Nilsson orbitals $3/2^+[624]$, $3/2^-[501]$, and $1/2^-[503]$. Evidence for considerable phonon–quasiparticle mixing in ^{187}Os is discussed. (3 figures, 3 tables) (auth)

46985 ISOBARS FROM THE SPALLATION REACTION FOR NUCLEAR SPECTROSCOPY. Arlt, R.; Bystrov, V. A.; Habenicht, W.; (and others) (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Instrum. Methods; 102: No. 2, 253-6(1972).

A method for isolation of radioactive nuclei of the isobars of some elements with a first ionization potential less than 6.5 eV from a target irradiated by 660 MeV protons is described. For this purpose an electromagnetic mass-separator and ion-source with surface ionization have been used. An estimation of the activities of the nuclei obtained on the collector of the mass-separator is done and methods for their identification are described. As an illustration, the experimental results of the Rb and Sr and some rare earth nuclei production are given. A new isotope ^{77}Rb ($T_{1/2}$ = 3.9 min) has been identified. (auth)

46986 STUDY OF DECAY OF STATES OF A NUCLEUS OF 89 NEUTRONS: ^{155}Dy. Torres, J. P. (Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse, Orsay, France); Paris, P.; Lecouturier, D.; Kilcher, P. Nucl. Phys., A189: No. 3, 609-31(1972). (In French).

The decay of ^{155}Ho to ^{155}Dy($T_{1/2}$ = 48 min) was investigated by means of Ge(Li) and Si(Li) detectors and a β-spectrograph having a homogeneous field. With the help of a multidimensional coincidence device, a scheme with 21 levels explained in terms of single-particle Nilsson-model and vibrational levels is proposed. To describe the sequence of the levels an important Coriolis coupling has to be introduced. The configurations involved and their band-head energies are for negative-parity levels: $3/2^-[521]$ (0 keV), $5/2^-[523]$ (136.3 keV), $3/2^-[532]$ (202.4 keV), and for positive-parity levels: $3/2^+[651]$ (240.3 keV), $1/2^+[660]$ (320.0 keV), $5/2^+[642]$ (408.5 keV). (auth)

46987 EXPERIMENTAL PROOF OF THE EXISTENCE OF TWO BRANCHINGS IN THE ROTATIONAL BAND $1/2^-$ [541] IN ^{171}Lu. Barneoud, D.; Foin, C.; Baudry, A.; Gizon, A.; Valentin, J. (Inst. of Nuclear Physics, Grenoble, France). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2291-4(Nov 1971). (In Russian).

The reaction ^{169}Tm$(\alpha,2n\gamma)^{171}$Lu was used to determine the rotational band and to detect branching for which $I + 1/2$ was an even, whole number. The experimental data also established the spacing of this $1/2^-[541]$ rotational band in ^{171}Lu. (K.S.W.)

46988 CORIOLIS COUPLING OF THE BANDS $1/2^-$ [541] AND $3/2^-$ [532] IN ^{171}Lu. Piepenbring, R. (Inst. of Nuclear Research, Grenoble, France). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2309-11(Nov 1971). (In Russian).

States of ^{171}Lu with a negative parity which arise from $h_{9/2}$-states in nuclei in the rare-earth region with odd proton number are discussed. Good development of bands have been observed for ^{171}Lu; accordingly this isotope was used to detect Coriolis pairing. The bands $1/2^-[541]$ and $3/2^-[532]$ were investigated, and the best agreement between experimental data and calculated data is obtained if the $3/2^-$-level is assumed to lie between 600 and 700 keV. (K.S.W.)

46989 HYPERFINE STRUCTURE OF THE GROUND STATE OF ^{165}Ho. Merzyn, G.; Penselin, S.; Wolber, G. (Univ., Bonn). Z. Phys.: 252: No. 5, 412-20(1972).

Four hyperfine structure frequencies were measured in the ground state $^4I_{15/2}$ of ^{165}Ho with high precision by using the atomic-beam magnetic resonance method at magnetic fields of up to 800 oersted. In the analysis of these measurements a possible electrical sedecimpole (16-pole) interaction was included. The following multipole interaction constants could be calculated: A = 800.582 8 (14) MHz, B = −1668.100 (91) MHz, C = −2224 (7520) Hz, D = −398 (790) Hz. Thus, within the limits of this experiment no octopole or sedecimpole interaction could be established. (4 tables) (auth)

46990 DIRECT MEASUREMENT OF THE NUCLEAR MAGNETIC DIPOLE MOMENT OF ^{165}Ho WITH THE ATOMIC BEAM MAGNETIC RESONANCE METHOD. Haberstroh, R. A.; Moran, T. I.; Penselin, S. (Univ., Bonn). Z. Phys.: 252: No. 5, 421-7(1972).

Four rf transitions between different Zeeman levels of the $^4I_{15/2}$ ground state of ^{165}Ho were measured in an external magnetic field of about 300 gauss with an atomic-beam magnetic resonance apparatus. The interaction between the nuclear magnetic dipole moment and the external field could be deduced from these measurements. Because the magnetic field was measured by calibration transitions in ^{39}K, ^{85}Rb, and ^{87}Rb, the following value could be determined for the nuclear magnetic dipole moment: $\mu_I(^{165}\text{Ho}) = 4.094(44)\ \mu_N$ (uncorrected for diamagnetic shielding). The g_J factor of the ground state of ^{165}Ho was measured to be $g_J(^4I_{15/2}, ^{165}\text{Ho}) = 1.1951445(40)$. (1 figure, 2 tables) (auth)

46991 2^+–2^+ TRANSITION OF 879 keV IN ^{160}Dy INVESTIGATED BY ELECTRON–GAMMA DIRECTIONAL CORRELATION. Zupancic, M.; Bikit, I.; Cvjeticanin, D.; Marinkov, L. (Boris Kidric Inst. of Nuclear Science, Belgrade). Z. Phys.; 252: No. 3, 237-41(1972).

$e-\gamma$ directional correlation measurements of the 2^+(879 keV)–2^+ (87 keV)–0^+ cascade in ^{160}Dy were made, and the magnitude of the electric monopole to quadrupole mixing ratio for the 879-keV transition was found to be $q_k = -0.03(10)$ for $\lambda = 0$ (λ according to the Hager–Saltzer definition). (2 figures, 1 table) (auth)

46992 MIXING OF TWO-PROTON BANDS WITH TWO-NEUTRON BANDS IN ^{176}Hf. Khoo, T. L.; Waddington, J. C.; O'Neil, R. A.; (and others) (McMaster Univ., Hamilton, Ont.). Phys. Rev. Lett.; 28: No. 26, 1717-20(26 Jun 1972).

Evidence for the interaction of high-spin two-quasiproton bands with two-quasineutron bands in ^{176}Hf is presented. The two $K^\pi = 6^+$ bands at 1333.1 and 1761.5 keV are shown to be of highly mixed character. A $K^\pi = 8^-$ band at 1559.4 keV, which is largely of two-proton character, is shown to be mixed with a predominantly two-neutron $K = 8^-$ band at 1860.3 keV. (auth)

46993 DEFORMATION PARAMETERS OF ^{152}Sm BY ELECTRON SCATTERING. Bertozzi, W. (Massachusetts Inst. of Tech., Cambridge); Cooper, T.; Ensslin, N.; (and others). Phys. Rev. Lett.; 28: No. 26, 1711-13(26 Jun 1972).

Cross sections for excitation of the ground-state rotational band in ^{152}Sm by high-energy electrons were measured. The ground-state charge distribution has been determined including the deformation parameters β_2 and β_4 of the nuclear surface. (auth)

46994 EFFECTIVE g_s FACTOR FOR THE ODD PROTON ^{153}Sm NUCLEUS DETERMINED BY THE INTERNAL CONVERSION PROCESSES. Krpic, D.; Milanovic, J.; Bikit, I.; Stepic, R. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). Z. Phys.; 253: No. 1, 71-7(1972).

The K/L_3, L_1/L_3, L_1/L_2, and L_2/L_3 conversion ratios for the 103-keV transition in ^{153}Sm were measured by means of a high-resolution $\pi\sqrt{2}$ electron spectrometer. The values of the M1 conversion penetration parameter $\lambda = 5.0^{+0.6}_{-0.5}$ and the mixing ratio $\delta^2 = 0.144 \pm 0.006$ are deduced. By comparing the experimental penetration parameter with the value obtained from Nilsson-model calculations the effective spin gyromagnetic ratio is found to be $g_s^{eff} = (3.7^{+0.4}_{-0.5})\ \mu_n$. (1 figure, 1 table) (auth)

46995 VALIDITY OF THE ROTOR MODEL IN THE ODD-Z NUCLIDE ^{171}Lu. Hjorth, S. A.; Ryde, H.; Skaanberg, B. (Univ. of Stockholm). J. Phys. (Paris); 33: No. 1, 23-6(Jan 1972).

A metallic thulium target was irradiated with 28-MeV α-particles to produce the ^{169}Tm$(\alpha,2n)^{171}$Lu reaction. The excitation functions for the observed γ-rays and the angular distributions of these γ-rays were studied. A search was made for isomeric transitions with half-lives longer than 10ns. The 137.05 keV γ-ray depopulating the $1/2^+[411]$ state into the $1/2^-[541]$ level was found to have a half-life of 33 ± 8 ns. No other delayed transitions were observed. Rotational bands built on the $1/2^+[411]$, $5/2^+[402]$, $7/2^+[404]$ (ground-state), $1/2^-[541]$ and $9/2^-[514]$ intrinsic states were obtained. The properties of these bands are examined with respect to deviations from the rotor model. Evidence is obtained of coupling term with $\Delta K = 2$, a variable moment of inertia explaining the available data. As usual the assumption of independent quasiparticle motion overestimates the effect of the Coriolis force. (France)

46996 BAND MIXING IN ^{156}Gd AND ^{158}Gd. Kluk, A. F. (Oak Ridge National Lab., Tenn.); Johnson, Noah R.; Hamilton, J. H. Z. Phys.; 253: No. 1, 1-12(1972).

A detailed investigation of the energies and intensities of the γ-rays that depopulate the low-spin levels of the β- and γ-vibrational bands of ^{156}Gd and the γ-vibrational band of ^{158}Gd was conducted. Both singles and $\gamma-\gamma$ coincidence measurements were made on sources of 15-d ^{156}Eu and 46-min ^{158}Eu by use of large-

volume, high-resolution Ge(Li) detectors. In addition to the γ band at 1154.09 keV, two $K^\pi = 0^+$ bands were observed in ^{156}Gd with band heads at 1049.45 and 1168.11 keV. The 2^+ and 3^+ members of the γ-vibrational band in ^{156}Gd were observed at 1187.12 and 1265.43 keV, respectively; a new $K^\pi = 0^+$ band was seen at 1195.98 keV. A first-order perturbational treatment of the branching ratios was applied to both nuclei. In addition, the mixing between the ground state, the β-, and the γ-vibrational bands of ^{156}Gd was considered from two approaches, but neither satisfactorily explains all the experimental B(E2) ratios. (3 figures, 2 tables) (auth)

46997 DECAY OF 1.4 Min ^{173}Er. Pursiheimo, V.; Tuurnala, T.; Raunemaa, T. (Univ. of Helsinki). Z. Phys.; 252: No. 4, 283-99(1972).

A (1.4 ± 0.1)-min activity, which is assigned to β^- decay of ^{173}Er, was produced with 14- to 15-MeV neutrons through the reaction ^{176}Yb(n,α)^{173}Er. Its decay was studied with Ge(Li) detectors and several $\gamma-\gamma$ as well as $\beta-\gamma$ coincidence arrangements. Eight gamma rays with energies 94.2, 116.14, 118.6, 122.40, 192.8, 199.2, 800.8, and 895.2 keV were assigned to the decay of ^{173}Er. The proposed level scheme of the daughter nuclide $^{173}_{69}$Tm contains levels at 0, 2.5, 118.6, 124.9, 317.7, 411.9, and 1212.8 keV. The 317.7-keV level is an isomeric state with a measured half-life of 10 ± 3 μs. This 10-μs isomer and the 411.9-keV level are thought to be the band head and $^9/_2^-$ rotational member of $^7/_2^-$ [523] Nilsson state, respectively. The levels at 0, 2.5, 118.6, and 124.9 keV are interpreted as $^1/_2^+$, $^3/_2^+$, $^5/_2^+$, and $^7/_2^+$ members of the $^1/_2^+$ [411] band; and the level at 1212.8 keV is interpreted as the $^9/_2^-$ [514] Nilsson state. Some systematic considerations and theoretical transition probability calculations are also included. (7 figures, 4 tables) (auth)

46998 GAMMA- AND X-RAYS IN THE DECAY OF ^{164}Ho. von Droste, G. Frh.; Pessara, W. (Physikalisch-Technische Bundesanstalt, Brunswick). Z. Phys.; 252: No. 4, 300-11(1972). (In German).

The photon spectrum in the decay of ^{164}Ho was investigated using a high-resolution solid-state detector separating the K x rays of Dy, Ho, and Er. The two γ rays depopulating the 3^+ and 2^+ levels in ^{164}Ho were found to have energies of 56.6 and 37.3 keV. The 91.4-keV radiation of Er from the sample seems to have a nonresolved high-energy component with about 2.5% intensity. It may be due to the cross-over transition $3^+ \rightarrow 1^+$ or a sum line. The half-life of the isomeric state of ^{164}Ho was found to be 36.7 ± 1 min. The total transition rates between different levels were calculated from the measured photon intensities. The fraction 0.27 found in the branching of the e^--capture feeding the 2^+ state of Dy has nearly the same value as the analog branching in the β^- decay. By combining the measured complex ground-state decay curve and the transition intensities of the isomeric and the ground state, the ground-state half-life was deduced; it was found to be (28.1 ± 1.0) min. The corresponding ratio of the ground-state and the isomeric-state production rates is 2.8_4: 1. A ratio of 0.04 was found for the cross sections of the ^{165}Ho(γ,3n)^{162}Ho and ^{165}Hoσ(γ,n)^{164}Ho reactions for a 90-MeV bremsstrahlung spectrum. (13 figures, 2 tables) (auth)

46999 NEW ISOTOPE ^{189}Tl. Vandlik, T. B.; Vandlik, Ya.; Zaitseva, N. G.; (and others) (Joint Inst. for Nuclear Research, Dubna, USSR). JETP Lett. (USSR) (Engl. Transl.); 15: No. 7, 271-4(5 Apr 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 7, 386-9(5 Apr 1972).

A PbF_2 target was bombarded by 660-MeV protons, the Tl was separated on-line, and the Tl fraction was separated with a mass separator. Gamma spectra were taken with a Ge(Li) detector having a resolution of 3.5 keV at 600 keV. After all known nuclides were taken into account, three gamma rays (of 216.3, 229.0, and 335 keV) were left: they were assigned to the decay of isotope ^{189}Tl with a half-life of 1.4 ± 0.4 min. (R.W.R.)

47000 MEAN LIVES OF SOME HIGH ENERGY LEVELS IN ^{160}Dy. Abou-Leila, Hussein; Darwish, Saher; Abdel-Haliem, A. F. Compt. Rend., Ser. B; 274: No. 14, 896-9(5 Apr 1972). (In French).

The mean life of the 1358.7 keV level of ^{160}Dy was determined using a double magnetic lens spectrometer and time-to-amplitude converters. An upper limit was determined for the 966.1 and 1264.7 keV excited levels. The following results were obtained: tau (1358.7 keV) = 3.9 ± 0.2 nsec, tau (966.1 keV) ≤ 20 psec, and tau (1264.7 keV) ≤ 15 psec. (France)

47001 NEW ISOTOPES OF TUNGSTEN. Nadzhakov, E.; Bochev, B.; Venkova, Ts.; (and others). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2207-12(Nov 1971). (In Russian).

In reactions of the composite nucleus with neutrons during the irradiation of ^{155}Gd and ^{156}Gd with heavy ions ^{22}Ne and ^{20}Ne there is produced neutron-deficient isotopes of tungsten. They were identified through their genetic association with the daughter isotopes of tantalum and hafnium. The new isotopes were identified as ^{171}W (9.0 ± 1.5 min) and ^{170}W (4 ± 1 min). (tr-auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts: 46461, 46883, 46909, 46916, 46973, and 47073.

47002 g-FACTOR OF THE 12^+ ISOMERIC STATE IN ^{206}Pb AND THE EFFECTIVE ORBITAL g-FACTOR OF THE NEUTRON. Nakai, K. (Univ. of Copenhagen); Herskind, B.; Blomqvist, J.; (and others). Nucl. Phys.; A189: No. 3, 526-38(1972).

The g-factor of the 12^+ two-quasiparticle isomeric state, $|(\nu i_{13/2})^{-2}|_{12^+}$, in ^{206}Pb has been measured by the time-differential perturbed angular correlation method. The result obtained is $g(12^+, {}^{206}\text{Pb}) = -0.155 \pm 0.004$. Three different methods are applied to deduce the orbital g-factor of the neutron around the ^{208}Pb core, namely (i) the M1 core polarization model, (ii) the configuration mixing model, and (iii) a combination of the M4 transition rate in ^{207}Pb with the present result. The g_l^{eff} (neutron) deduced in the three different ways are in good internal agreement: (i) −0.036 ± 0.010, (ii) −0.040 ± 0.03 and (iii) −0.034 ± 0.010. Although it is hard to estimate the overall uncertainty, it is probably significant that the anomaly in the orbital g-factor of the neutron has opposite sign from that of the proton, and that the size is smaller. From known g-factors in the lead region the polarization part δg_s and $\delta g_s'$ of the g-factor of the neutron can be derived. These values are $\delta g_s = 2.77 \pm 0.15$ and $\delta g_s' = -3.30 \pm 0.22$. By comparing the experimental g-factors for the $i_{13/2}$ proton and neutron we find that the part of the g-factor deviating from the Schmidt line has an isovector character. This means that δg_s and $\delta g_s'$ should have the same magnitude but opposite sign for the proton. Calculated g-factors based on this conclusion agree well with the experimental g-factors for the $h_{9/2}$ and $i_{13/2}$ protons. (auth)

47003 DECAY OF ^{194}Au. Vishnevskii, I. N.; Gavrilyuk, V. I.; Kupryashkin, V. T.; (and others). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2213-31(Nov 1971). (In Russian).

The e^- spectrum of ^{194}Au ($T_{1/2}$ = 39.5 hr) was investigated on the iron β-spectrometer $\pi\sqrt{2}$, r_0 = 50 cm, with a resolution of 0.03 to 0.04%, and the accompanying γ spectrum was determined on the Ge(Li) detector with a resolution of 4 keV. The multipole order of the majority of transitions was established; a mixture of multipole orders were confirmed according to the ratio of intensities of the conversion lines in the L- and M-subshells for many transitions. Many new transitions were detected in the e^- spectrum. A decay scheme was constructed. (tr-auth)

47004 α-DECAY OF NEUTRON-DEFICIENT ISOTOPES OF RADON. Golovkov, N. A.; Ivanov, R. B.; Kolachkovski, A.; Norseev, Yu. V.; Chumin, V. G. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2272-80(Nov 1971). (In Russian).

The α-spectra of Rn isotopes having masses of 206 ≤ A ≤ 212 were investigated with a magnetic α-spectrograph. New α-transitions were detected, and their relative intensities were measured. Earlier α-group energies and a portion of the α-decay scheme were revised to provide better accuracy. The dependence of $T_{1/2}$ or E_α was studied for isotopes with neutron numbers N > 128 and N ≤ 128. (tr-auth)

47005 K CONVERSION COEFFICIENT NEAR THRESHOLD: ^{191m}Os. Kirschner, H. (Univ., Goettingen, Ger.). Z. Phys.; 252: No. 3, 249-54(1972). (In German).

The K-conversion coefficient of the predominantly M3 transition ^{191m}Os – ^{191}gOs E_γ = 74.37 keV was measured to be α_K = 131 ± 12. This differs from other measurements and from theoretical values. (3 figures) (auth)

47006 DECAY OF ^{210}At TO LEVELS IN ^{210}Po. Jardine, L. J.; Prussin, S. G.; Hollander, J. J. (Univ. of California, Berkeley). Nucl. Phys.; A190: No. 2, 261-83(1972).

The electron-capture decay of ^{210}At has been reinvestigated and present data define twenty-three levels in ^{210}Po. The multipolarity of thirty-six transitions has been measured and combined with data from recent reaction studies to assign spins and parities to these levels. Evidence is presented which locates the 3^- collective level in ^{210}Po at 2387 keV above the ground state. The electron-capture transition rates to odd-parity levels are discussed with reference to the particle-hole excitations in ^{208}Pb. Transition probabilities for γ-decay of members of the $\pi(h_{9/2}f_{7/2})$ multiplet are compared to predictions from recent theoretical calculations. (auth)

47007 FIRST FORBIDDEN BETA DECAY OF ^{209}Pb. Behrens, H.; Kobelt, M.; Thies, W. G.; Appel, H. (Univ., Karlsruhe, Ger. Kernforschungszentrum, Karlsruhe, Ger.). Z. Phys.; 252: No. 4, 349-61(1972).

The $^{9}/_{2}^{+} \rightarrow {}^{9}/_{2}^{-}$ first-forbidden β transition of ^{209}Pb $\rightarrow$ ^{209}Bi was investigated. The end-point energy was determined to be (644.6 ± 1.2) keV; the half-life to be (3.253 ± 0.014) h. For the shape factor no deviation from the allowed form was found within an accuracy of 1%. The shape factor and ft-value can be excellently interpreted by the shell model in jj coupling. (auth)

47008 VERY INELASTIC SCATTERING OF ALPHA PARTICLES FROM HEAVY NUCLEI. Halpern, I. (Univ. of Washington, Seattle. Univ. of Copenhagen). pp 255-62 of Problems of Modern Nuclear Physics. /Kolybasov, V. M. (ed.). Moscow; Izdatel'stvo Nauka (1971).

From second symposium on the problems of nuclear physics; Novosibirsk, USSR (12 Jun 1970).

Energy spectra and cross sections were measured for (α,α'), $(\alpha,^{3}He)$, $(^{3}He,^{3}He')$, and $(^{3}He,\alpha)$ reactions on ^{181}Ta, ^{197}Au, and ^{208}Pb for bombarding energies of about 50 up to 80 MeV. The observed structure in the spectra and cross sections is discussed. (J.W.R.)

47009 NUCLEAR ENERGY LEVELS IN EVEN ISOTOPES OF LEAD FROM (alpha,xn) REACTIONS ON SEPARATED MERCURY ISOTOPES. Burns, Erskine John Thomas. Davis, Calif.; Univ. of California (1971). 355p. University Microfilms Order No. 72-17,899.

Thesis.

Levels in ^{206}Pb, ^{204}Pb, ^{202}Pb, ^{200}Pb and ^{198}Pb are identified with 30 to 55 MeV. (α, xn) reactions on enriched Hg targets with x = 2 and 4. The data includes in-beam, beam-swept and off-beam gamma-ray spectra corresponding to time distributions of 3 to 125 nanoseconds, 100 to 625 nanoseconds and greater than .1 seconds; along with in-beam conversion electrons. Assignments of levels are based on relative intensities, both prompt (<3 ns.) and delayed (>3 ns.), relative excitation functions, conversion coefficients, and energy level systematics. New $(7)^{-}$ isomers (>3 nsec.) are assigned to ^{202}Pb, ^{200}Pb and ^{198}Pb with half-lives of 80 nsec., 310 nsec , and greater than 1 μ sec; respectively. These isomers are believed to be two-particle (quasi-particle) configuration mixed states made up of the $(i_{13/2}, p_{9/2})$, $(i_{13/2}, p_{1/2})$ and $(i_{13/2}, f_{5/2})$. Energy level systematics and transition probabilities tested the following microscopic models: (1) strict shell model; (2) pairing plus quadrupole model; (3) surface delta residual interaction; and (4) extended shell model with a realistic residual interaction. States populated via (α, xn) on lead are shown to be relatively pure two-particle (quasi-particle) levels. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts: 46148, 46461, 46889, 46966, 47042, and 47595.

47010 (ANCR-1060) TOTAL NEUTRON CROSS SECTION OF ^{243}Am FROM 0.5 TO 1000 eV. Simpson, O. D.; Simpson, F. B.; Harvey, J. A.; Slaughter, G. G.; Benjamin, R. W.; Ahlfeld, C. E. (Aerojet Nuclear Co., Idaho Falls, Idaho). Mar 1972. Contract AT(10-1)-1375. 95p. Dep. NTIS.

Transmission measurements were made on two high-purity samples of ^{243}Am having inverse thicknesses of 1288.2 and 279.3 b/a. Data were collected from 0.5 to 1000 eV using the Oak Ridge Electron Linear Accelerator. High-resolution data were taken using 10-ns, 140-MeV electron bursts, 10-ns channel widths, and a flight path of 18.576 meters. Single-level Breit-Wigner resonance parameters were obtained from area analysis below 250 eV. The resonance parameters were also determined below 18 eV from shape analysis. From an analysis of 24 resonances an average value of $\Gamma_\gamma = 39 \pm 1$ MeV was determined. The average observed level spacing between resonances was found to be 0.67 ± 0.06 eV. A neutron S-wave strength function of $(0.96 \pm 0.10) \times 10^{-4}$ was determined from the resonance parameters. The resonance-absorption integral for neutrons with energies above 0.625 eV was calculated to be 1813 ± 68 b. (22 figures, 6 tables) (auth)

47011 (BNWL-1648) PHOTON INTENSITIES AND THEIR IMPORTANCE IN COUNTING TRANSURANIC MATERIALS. Swinth, K. L. (Battelle Pacific Northwest Labs., Richland, Wash.) May 1972. Contract AT(45-1)-1830. 28p. Dep. NTIS.

Ratios of x-ray to alpha intensities are presented for a number of transuranic materials, and how these ratios can vary with changing isotopic composition is illustrated. Plutonium is used as an example. Also shown is how the biological hazard as measured by the maximum permissible body burden (MPBB) can vary with isotopic composition for plutonium. Plutonium from spent power reactor fuels presents a greater hazard on a unit weight basis than high-grade fissile material. The x-ray intensity is initially smaller for the power reactor material but increases as the ^{241}Am grows into the material. In fact, the x-ray intensity will eventually be greater than that from the high-grade material. Although the isotopic composition is an important facet in determining the biological hazard and in interpreting the photon intensities from transuranic materials, it is not the only complication in interpretation of counting data. The low penetrating power (absorption) and, because of this, the manner in which the material is deposited will also affect the interpretation of counting data. (15 figures, 1 table) (auth)

47012 (CEA-N-1526) LIBRARY OF DATA FOR FISSION PRODUCTS (THIRD EDITION). Blachot, Jean; de Tourreil, Roland (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Mar 1972. 272p. (In French). Dep. NTIS (U. S. Sales Only).

The third version of the library of fission product data is presented. Two tables give a description of the nucleides and gamma transitions. (France)

47013 (COO-3058-23) MeV TOTAL NEUTRON CROSS SECTIONS OF ^{238}U. Hayes, S. H.; Stoler, P.; Clement, J. M.; Goulding, C. A. (Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Physics). 1972. Contract AT(11-1)-3058. 16p. Dep. NTIS.

A measurement of the total neutron cross sections of ^{238}U was made using the RPI electron LINAC. The operating electron energy was about 60 MeV, and the beam burst width was 20 ns. The neutron energies were determined using the time-of-flight technique with a resolution of .08 ns/m. The cross sections are presented from 0.8 to 30.0 MeV. The cross section curve is smooth in this region, and the averaged data have a statistical precision of 1%. The data reported here have been compared with other recent measurements and with the ENDF-B file. There is generally good agreement with a few percent deviations in certain energy regions. In addition, the experimental cross sections were fit using coupled channel code JUPITOR to obtain optical model and deformation parameters. (auth)

47014 (FRNC-TH-184) CHEMICAL SEPARATION AND HIGH RESOLUTION NUCLEAR SPECTROSCOPY IN THE ^{228}Ra $\rightarrow$ ^{228}Ac $\rightarrow$ ^{228}Th RADIOACTIVE CHAIN. Herment, Micheline (Grenoble Univ. (France). Faculte des Sciences). 1971. 70p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The ^{228}Ra $\rightarrow$ ^{228}Ac $\rightarrow$ ^{228}Th decay scheme was studied in order to precise the nuclear properties of the odd-odd Ac nucleus. The results were obtained by γ spectrometry, $\gamma-\gamma$ coincidence spectrometry, electron spectrometry, and $e-\gamma$ coincidence spectrometry. 190 transitions were examined in the framework of this study, which enabled the modes of excitation, and the intrinsic states of the deformed nuclei to be investigated. Examination of the exact ratios of the transition probabilities allowed a comparison to be made with theoretical predictions and the confirmation or proposition of certain levels. A level scheme is presented for ^{228}Th and ^{228}Ac. The chemical separation methods used to obtain ^{228}Ra from ^{232}Th, and the preparation of ^{228}Ac and ^{228}Ra sources are presented. (France)

47015 (INDC-7-U) PROCEEDINGS OF THE TOPICAL CONFERENCE ON "NEUTRON INDUCED FISSION" HELD DURING THE FOURTH INDC MEETING, BHABHA ATOMIC RESEARCH CENTER, BOMBAY, WEDNESDAY, JULY 14, 1971. (International Nuclear Data Committee. International Atomic Energy Agency, Vienna (Austria)). 162p. (CONF-710725).

Separate abstracts were prepared for 10 of the 11 papers included. The remaining paper is a brief summary containing no data. (J.W.R.)

For abstracts of individual papers see: 47016-47021 and 47043-47046.

47016 (INDC-7-U, pp 23-5) DID SUPERHEAVY NUCLEI EXIST IN OUR SOLAR SYSTEM? Bhandari, Narendra (Tata Inst. of Fundamental Research, Bombay (India)).

From fourth meeting on neutron induced fission; Bombay, India (14 Jul 1971).

The available evidence on the existence of superheavy elements is evaluated and the results are discussed in terms of their possible physical and chemical properties. There are two lines of evidences, both obtained from a study of primitive objects of our solar systems, the meteorites and lunar dust grains which indicate that superheavy elements were extant at the time these objects solidified. The rare gas evidence based on the presence of an

anomalous component of fissiogenic xenon has been discussed in detail by Anders and Heymann (1969) and by Rao (1970). Recently Bhandari et al (1971) have observed fission fragment tracks characteristic of nuclei Z > 110. These tracks are present in a number of meteorites. The estimated number of tracks due to ^{244}Pu and element Z > 110 relative to ^{238}U as observed in certain enriched regions of the silicate crystals are given. Based on these observations arguments are developed for possible chemical nature of elements responsible for the characteristic long (>15 micron) tracks. The fact that the meteorite Angra Dos Reis is highly depleted in such tracks but unusually enriched in U, Pu, Ba etc. lead us to conclude that the element(s) may not be a chemical homologue of these groups. However its exact chemical properties can not be ascertained from the available data. Near absence of the superheavy tracks in lunar rocks which are younger by about 1 billion years indicates that they must have a half life $\gtrsim 10^8$ years and must now be extinct. (auth)

47017 (INDC–7–U, pp 31–59) MASS DISTRIBUTIONS IN FISSION AND SOME RELATED PHENOMENA. Felvinci, J.; Melkonian, E.; Havens, W. W. Jr. (Columbia Univ., New York).

From fourth meeting on neutron induced fission; Bombay, India (14 Jul 1971).

Some experiments on mass distribution and related phenomena in fission are discussed. The systematics of mass distributions are reviewed. Topics discussed include the fission fragment mass distribution, variation with mass of the fissioning nucleus, mass distribution as a function of fragment kinetic energy, primary and post-neutron mass distributions and prompt neutron emission, effect of energy on the mass distribution, variations of mass distribution with spin and/or K quantum number, and effects of mass distribution on cross measurements. (J.W.R.)

47018 (INDC–7–U, pp 61–4) FISSION ISOMERIC STATE IN ^{236}U. Derengowski, M. A.; Felvinci, J. P.; Melkonian, E. (Columbia Univ., New York).

From fourth meeting on neutron induced fission; Bombay, India (14 Jul 1971).

A delayed fission activity with a half-life of 7 ± 1 nsec was found in the neutron fission of ^{235}U at neutron energies of a few hundred eV up to about 3 keV. A lower limit of 2% was set for the delayed fission relative to prompt fission. (J.W.R.)

47019 (INDC–7–U, pp 89–112) PROMPT RADIATIONS EMITTED IN LOW ENERGY FISSION. Nadkarni, D. M. (Bhabha Atomic Research Centre, Bombay (India)).

From fourth meeting on neutron induced fission; Bombay, India (14 Jul 1971).

The emission of prompt radiation in fission, including neutrons, γ-rays, conversion electrons, x-rays, and long range charged particles is discussed. Some experimental results are presented and some previous work is reviewed. (J.W.R.)

47020 (INDC–7–U, pp 113–29) RECENT STUDIES ON PROMPT NEUTRON AND GAMMA RAYS FROM FISSION. Conde, H. (Forsvarets Forskningsanstalt, Stockholm (Sweden)).

From fourth meeting on neutron induced fission; Bombay, India (14 Jul 1971).

Some recent experiments on prompt neutron and γ-ray emission in fission are reviewed. Special emphasis is given to results on average prompt neutron yields and fission neutron spectra. (J.W.R.)

47021 (INDC–7–U, pp 131–44) RADIATIONS EMITTED IN FISSION. Ribon, Pierre.

From fourth meeting on neutron induced fission; Bombay, India (14 Jul 1971).

The properties of the various particles which are emitted during or after the fission process are briefly examined. Their emission can occur at three different stages: 1- at the scission time. They are mainly α particles and other light particles; the results for these emissions are numerous and coherent, and allow to obtain informations on the scission configuration. On the contrary, the neutron emission is not well enough known. 2- by the fission fragments. These deexcited mainly by neutron emission; nevertheless, if they have high spin values (I ~ 15), γ-ray emission is expected to compete strongly with the neutron emission. But some very recent results give lower spin values (I ~ 7). 3- by the fission products. The delayed neutron precursors are now quite well known, and the interest is turning more and more upon their energy spectra. The calculations which have been done to fit the previously known spectra does not describe the structure of the most recent results. (auth)

47022 (JINR–P7–6466) ANGULAR DISTRIBUTION OF FRAGMENTS OF SPONTANEOUSLY FISSIONING ISOMERS. Gangrskii, Yu. P.; Nguyen Cong Khan; Pulatov, D. D.; Fam Zui Hein (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1972. 15p. (In Russian). Dep. NTIS (U. S. Sales Only).

Measurements were made of the angular distributions of the fragments from the spontaneously fissioning isomers ^{236}Pu, ^{237}Pu and ^{243}Cm, produced in α-particle reactions. Anisotropy of the angular distribution was observed for ^{236}Pu and ^{237}Pu isomers. The effects of the neutrons and of γ quanta, emitted from the compound nucleus, as well as of extranuclear magnetic fields, on the angular anisotropy are discussed. (5 figures, 1 table) (auth)

47023 (KFK–1537) PREPARATION AND INVESTIGATION OF THE NEPTUNIUM ISOTOPES 231, 232, AND 233. Weiss-Reuter, R. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie). Dec 1971. 54p. (In German). Dep. NTIS (U. S. Sales Only).

The decay of $^{231}_{93}$Np, $^{232}_{93}$Np, and $^{233}_{93}$Np was studied by γ-ray spectroscopy. All three isotopes decay predominantly by electron capture. For $^{232}_{93}$Np 24 γ-ray transitions were detected. An extended decay scheme is given. For $^{233}_{93}$Np and $^{231}_{93}$Np 21 and 15 γ-ray transitions, respectively, were observed; decay schemes for these isotopes are proposed. (16 figures, 18 tables) (auth)

47024 (KFK–1563) MEASURE OF THE RATIO OF CAPTURE-TO-FISSION CROSS SECTION FOR ^{235}U AND ^{239}Pu BETWEEN 8 AND 60 keV NEUTRON ENERGY. Bandl, Rolf-Eckart (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik). Mar 1972. 71p. (In German). Dep. NTIS (U. S. Sales Only).

The ratio of capture to fission cross section, α, has been measured for ^{235}U and ^{239}Pu in the neutron energy range from 8 to 60 keV. A 3 MV Van-de-Graaff accelerator generated a pulsed proton-beam. The ^{7}Li(p,n)^{7}Be reaction was used as the neutron-source. The absorption was found by a comparison of the scattered neutrons from a fissile sample with those from a non-absorbing lead sample. Simultaneously the fast fission neutrons were detected with an organic liquid scintillator. The neutron energy was determined by the time-of-flight method, the time resolution was about 20 ns/m. The measurements were normalized between 40 and 50 keV to the results of recent evaluations. The error in α amounts to 15% between 10 and 40 keV neutron energy. (auth)

47025 PROMPT GAMMA DECAY OF FISSION FRAGMENTS. Sarkar, R. (Saha Inst. of Nuclear Physics, Calcutta); Chatterjee, A. Phys. Lett.; 33B: No. 4, 263-7(26 Oct 1970).

Prompt γ-ray energies and yields from fission fragments for the thermal neutron fission of ^{235}U and spontaneous fission of ^{252}Cf are calculated from an improved renormalized Fermi gas model and the collective potential energy surface concept. The predictions agree fairly well with the experimental observations. (auth)

47026 FISSION OF ALIGNED ^{233}U NUCLEI BY NEUTRONS FROM 0.4 TO 2000 eV. Kuiken, R. (Kamerlingh Onnes Laboratorium, Leiden); Pattenden, N. J.; Postma, H. Nucl. Phys.; A190: No. 2, 401-18(1972).

The anisotropy in the angular distribution of fission fragments from neutron-induced fission of aligned ^{233}U has been measured as a function of neutron energy from 0.4 to 2000 eV. The ^{233}U nuclei were aligned in thin layers of monocrystalline rubidium uranyl nitrate, effectively cooled to about 0.3 K. The variation in the anisotropy over the resonances in the energy region from 0.4 to 60 eV and also over the unresolved region from 60 to 2000 eV was found to be rather small: Comparing the experimental distribution of anisotropy values with theoretical distributions showed, that for the J = 3 resonances, channels with K = 3 are not open; K being the projection of the compound spin J on the deformation axis. Channels with $(J^{\pi}; K) = (2^{+}; 2)$ are at most partially open. Several channels must be assumed to be open in order to explain the experimental distribution. A slight systematic variation observed in the anisotropy values averaged over 100 eV intervals may indicate the presence of intermediate structure. (auth)

47027 MASS YIELDS FROM THERMAL-NEUTRON INDUCED FISSION OF ^{245}Cm. Harbour, R. M.; MacMurdo, K. W. (E. I. du Pont de Nemours and Co., Aiken, S. C.). J. Inorg. Nucl. Chem.; 34: No. 7, 2109-14(Jul 1972).

The fission yields of 21 mass chains were measured for the thermal-neutron induced fission of ^{245}Cm. Fission product gamma activities from ^{245}Cm were determined relative to those from ^{235}U with a high resolution lithium-drifted germanium detector. The measured errors ranged from 1 to 10% over a mass number range of 85 to 147. No significant fine structure in the mass yield curve was apparent. (auth) (UK)

47028 CONVERSION TRANSITIONS IN ^{226}Ra. Tret'yakov, E. F.; Tret'yakova, N. I.; Konyaev, V. F. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2306-8(Nov 1971). (In Russian).

Internal conversion electron spectra which accompanied the α decay of ^{230}Th were measured. The E1 transitions with energies 186 and 253 keV in ^{226}Ra were determined. (tr-auth)

47029 ENERGY LEVELS IN ^{231}Th AND ^{233}Th. Grotdal, T.; Limstrand, J.; Nybo, K.; Skar, K.; Thorsteinsen, T. F. (Univ. of Bergen. Univ. of Copenhagen). Nucl. Phys.; A189: No. 3, 592-608(1972).

The energy levels of ^{231}Th and ^{233}Th have been studied by the (d,t) and (d,p) reactions at deuteron bombarding energies of 12 and 13 MeV. The scattered particles were analysed in a magnetic spectrograph at angles of observation of 60°, 90° and 125°. A total of 9 Nilsson orbitals in ^{231}Th and 7 Nilsson orbitals in ^{233}Th were identified on the basis of the total cross sections and the intensity patterns for the rotational states. The influence of Coriolis mixing was taken into account. (auth)

47030 ON-LINE MEASUREMENTS OF RARE-GAS FISSION YIELDS IN 14 MeV NEUTRON FISSION. Bocquet, J. P.; Brissot, R.; Crancon, J.; Moussa, A. (CEN, Grenoble, France). Nucl. Phys.; A189: No. 3, 556-76(1972).

The independent and cumulative fission yields of rare-gas isotopes produced from the fission of ^{233}U, ^{235}U, ^{238}U and ^{232}Th by 14 MeV neutrons have been measured by means of on-line isotopic separation. Chain yields can be deduced from the cumulative yields and Gaussian curves fitted to the independent yield distributions. Values of $Z_p - Z_{UCD}$ and σ_z have been compared with those obtained from other fissioning systems. The total number of neutrons, ν_{tot}, emitted in ^{232}Th fission has been estimated. (auth)

47031 STUDY OF X-RAYS AND NUCLEAR γ-RAYS IN MUONIC THALLIUM. Backe, H.; Engfer, R.; Jahnke, U.; (and others). (CERN, Geneva). Nucl. Phys.; A189: No. 3, 472-512(1972).

Energies and intensities of muonic x-rays, nuclear γ-rays and μ-capture γ-rays were measured in natural muonic thallium with Ge(Li) detectors. The absolute intensities of higher μ x-rays were reproduced by a cascade calculation starting with a statistical population at n = 20 including K-, L- and M-conversion. The electron screening effect was deduced from energies of higher μ x-rays. Eight prompt nuclear γ-rays were found, due to an excitation of (4.1 ± 1.0)% and (14.6 ± 3.0)% of the first $3/2^+$ level in μ^{203}Tl and μ^{205}Tl, respectively, and of (8.8 ± 0.9)% of the $5/2^-$ level at 2.63 MeV in ^{205}Tl. This excitation explains the anomalous intensity ratios of the 2p-1s and 3d-2p fine structure components. From the nuclear γ-rays of the first excited states were deduced: the magnetic hf splittings $\epsilon^{203}(1/2) = 2.57 \pm 0.15$ keV, $\epsilon^{205}(1/2) = 2.30 \pm 0.02$ keV, muonic isomer shifts ΔE_{1s} (203) = 0.26 ± 0.15 keV, ΔE_{1s} (205) = −(0.31 ± 0.11) keV; E2/M1 mixing ratios δ_μ^2 (203) = 0.89 ± 0.27, δ_μ^2 (205) = 1.00 ± 0.05, and the half-life in the presence of the muon T_μ (3/2) = 1.4 ± 0.1 nsec in ^{205}Tl. The values of $\epsilon(1/2)$ and ΔE_{1s} were compared with shell-model calculations. From δ_μ^2 and T_μ (3/2) evidence for a magnetic nuclear polarization was found. From the 2p-1s, 3d-2p, 3p-2s and 2s-2p transitions the size and shape of the nuclear charge distribution and a nuclear polarization due to the $1s_{1/2}$ muon of ΔE_{np} = 8.3 ± 1.2 keV and 9.5 ± 1.2 keV for ^{203}Tl and ^{205}Tl respectively were determined in agreement with theoretical estimates. An isotope shift of ΔE = 10.35 ± 0.25 keV was measured for the $1s_{1/2}$ state which is compared with data from optical spectroscopy. From an analysis of the time distribution of delayed γ-rays from μ-capture, an isotopic effect of (5.4 ± 2.5)% was found for the capture rates, in fair agreement with predictions from Primakoff's μ-capture formula. (auth)

47032 HARD GAMMA RADIATION FROM ^{238}Pu. Makarenko, A. I.; Ostretsov, L. A.; Forafontov, N. V. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2335-7(Nov 1971). (In Russian).

The γ radiation from three sources, prepared from metallic Pu with activities of 5.7, 8.8, and 17.0 Ci, was investigated. During a determination of the relative intensity, the varying effectiveness of the detector at different γ quantum energies and varying degrees of absorption in the lead filter were taken into account. The results are compared with the γ spectra of ^{234}Pa and ^{234}Np. Besides the known γ lines with energies at 743.0, 767.0, and 786.0 keV, there were also observed γ lines at 707, 807, 852, 882, 926, 945, 1,002, 1,039, and 1,083 keV, all of which accompany the α decay of Pu. A revised decay scheme for ^{238}Pu is presented. (K.S.W.)

47033 SUBBARRIER FISSION RESONANCES IN Th ISOTOPES. Back, B. B.; Britt, H. C.; Garrett, J. D.; Hansen, Ole (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. Lett.; 28: No. 26, 1707-10 (26 Jun 1972).

Subbarrier fission resonances have been found in ^{230,232}Th(t,pf) and ^{230}Th(d,pf) reactions. This is in disagreement with the fission barriers predicted by the Strutinskĭ theory. (auth)

47034 GAMMA BRANCHING AND TOTAL CONVERSION COEFFICIENTS OF INTRABAND TRANSITIONS IN THE GROUND-STATE ROTATIONAL BAND OF ^{245}Cm. Schmidt-Ott, W.-D.; Fink, R. W. (Georgia Inst. of Tech., Atlanta). Z. Phys.; 253: No. 1, 13-16(1972).

With calibrated Ge(Li) detectors, $\gamma-\gamma$ coincidences were observed in the decay of ^{249}Cf. The total conversion coefficients of the 54.7- and 66.7-keV transitions in the first rotational band were determined to be 237 ± 30 and 69 ± 15, respectively. The branching ratio of the 121.5-keV crossover transition is (22 ± 7)%. The errors are the 2σ statistical uncertainties, linearily added to the errors in the detector efficiencies. (auth)

47035 TRANSFER REACTIONS OF A LARGE NUMBER OF NUCLEONS INDUCED BY ^{84}Kr ON ^{232}Th: STUDY OF THE REACTION THRESHOLDS. Bimbot, R.; Gauvin, H.; Le Beyec, Y.; (and others) (Institut Physique Nucleaire, Orsay, France). Nucl. Phys.; A189: No. 3, 539-44(1972). (In French).

Excitation functions have been measured for the formation of ^{225}Th, ^{226}Th, ^{223}Ac, and ^{224}Ac, when ^{232}Th was bombarded by ^{84}Kr ions at energies ranging between 450 and 494 MeV. The thresholds of all the reactions appear at 450 MeV (330 MeV c.m.), a higher energy than expected. Cross sections of the order of 1 mb are reached for these transfer reactions corresponding to a large number of neutrons. The results are compared with the same reactions induced with lighter projectiles. (auth)

47036 MEASUREMENTS ON FISSILE NUCLIDES. Moore, M. S. (Idaho Nuclear Corp., Idaho Falls). pp 347-508 of Experimental Neutron Resonance Spectroscopy. /Harvey, J. A. (ed.). New York; Academic Press, Inc. (1970).

After an introduction on the development of fission theory and fission as a multistage process sections are included on experimental methods in low-energy neutron spectroscopy of fissile nuclides, cross-section measurements on common fissile isotopes in the resonance region, fragment angular distributions and fission near threshold, the scission point and nuclear structure of the fragments, and the question of spin dependence of the mass distribution. The relationships among the various multilevel approaches to resonance structure are treated in an appendix. In addition, an extensive list of references is included. (J.W.R.)

47037 LONG RANGE ALPHA PARTICLE EMISSION IN THE FISSION OF HEAVY ELEMENTS. Rajagopalan, Mahalingam. Princeton, N. J.; Princeton Univ. (1971). 103p. University Microfilms Order No. 72-14,163.

Thesis.

Emission of alpha particles in the spontaneous fission of ^{252}Cf and in the proton induced fission of ^{238}U was investigated. The angular distribution of alpha particles emitted in coincidence with light as well as heavy fragments were determined in the spontaneous fission of ^{252}Cf. The FWHM (Full width at half maximum) for the angular distribution of alpha particles emitted in coincidence with light fragments was found to be 23 degrees (distinctly narrower than has been previously reported). The FWHM for the angular distribution of alpha particles emitted in coincidence with all the fragments was found to be 37½ degrees. Trajectory calculations were done to find the best set of initial parameters that give rise to the angular distribution of alpha particles in agreement with experiment. The results are consistent with the sudden snap mechanism of alpha particle emission proposed by Halpern. They are also compatible with the adiabatic model of fission and contradictory to predictions by the statistical model. The dependence of the probability of alpha particle emission in fission on excitation energy was investigated by measuring the emission rates in the fission of ^{238}U induced by 16-MeV and 42-MeV protons. It was found that the probability of alpha particle emission in 42-MeV proton induced fission was 20 ± 5% higher than in the case of 16-MeV proton induced fission. A least square analysis was done with the available data on the alpha particle emission rates in fission induced by intermediate energy projectiles and the best fit was given by $Y_\alpha = (1.658 \pm 0.03) + (0.0217 \pm 0.0015)\ E^*$ where Y_α is the alpha particle emission probability per thousand binary fissions and E^* is the excitation energy of the fissioning system. The observed increase in the alpha particle emission rate with increase in excitation energy is consistent with expectations from the two-mode fission hypothesis. (Diss. Abstr. Int., B)

Nuclear Theory

Refer also to abstracts: 46466, 46508, 46644, 46658, 46787, 47015, and 47209.

47038 (BNL-tr-487) CHANGE IN THE MECHANISM OF INELASTIC INTERACTIONS BETWEEN PARTICLES AND NUCLEI IN THE ENERGY REGION T ≃ 5 GeV. Barashenkov, V. S.; Gudima, K. K.; Toonev, V. D. (Joint Inst. for Nuclear Research,

Dubna (USSR)). Translated for Oak Ridge National Lab., Tenn., from report JINR-P2-4302. 9p. Dep. NTIS.

The analysis of the available experimental data on inelastic nucleon– and meson–nucleus interactions shows that the energy dependence of different characteristics connected with the cascade and evaporation particle production is changed in the energy region T ≈ 5 GeV. This change is of "saturation" character, and an essential modification of the conventional intranuclear cascade model is required for its interpretation. One of the possible explanations is based on the progressive decrease of the number of nucleons in the nucleus as the intranuclear cascade develops. (4 figures) (auth)

47039 (BNL-tr-488) SELF-CONSISTENT FIELD METHOD AS APPLIED TO THE NUCLEUS. Kompaneets, A. Translated by S. J. Amoretty (Brookhaven National Lab., Upton, N. Y.), from Dokl. Akad. Nauk SSSR; 85: No. 2, 301-4(1952). 8p. Dep. NTIS.

The self-consistent field method is used to explain, in general terms, certain regularities in nuclear structure: the approximate constant energy and volume per nucleon. Many constants of the nuclear force being unknown, the work is formulated in a way that minimizes the use of specific numerical values. (R.W.R.)

47040 (BNL-tr-489) TOWARD THE THEORY OF NUCLEAR SHELLS. Ivanenko, D. D.; Sokolov, A. A. Translated for Brookhaven National Lab., Upton, N. Y., from Dokl. Akad. Nauk SSSR; 74: No. 1, 33-6(1950). 7p. Dep. NTIS.

An approximate general formula is derived for the "critical" numbers N of nucleons completing successive nuclear shells as a function of the nucleonic density ρ. The statistical method of Fermi, which had already been employed for the approximate deduction of critical numbers of electrons in an atom, was followed. The statistical model leads directly to the formula $N = (21 + 1)^3/24\ \pi^2 r^3 \rho$. Assuming a certain distribution of ρ, the N's are obtained successively for l = 0, 1, 2, 3, etc. By taking ρ = constant, for heavy nuclei, one gets N = 0, 1, 2, 6, 12, 24, 38, 60, 86, 122 ... If, for light nuclei, ρ is assumed to vary continuously in space, the numbers obtained are N = 2, 10, 28, 60, 110 ... The assumptions having an approximate, preliminary value only, the results should be regarded as giving only a certain general answer to the problem. Corrections, such as that for the Coulomb interaction between protons, or that for the effect of the surface layer, could be introduced. Valente [Phys. Rev. 78: 77(1950)] is an analysis of the empirically known series of "magic" numbers, obtained the formula $N = (l^3 + 51)/3$ which is related to that given above. (TSS)

47041 (CEA-N-1529) GEOMETRICAL PROPERTIES OF NUCLEAR REACTIONS. Raynal, Jacques (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Mar 1972. 118p. (In French). Dep. NTIS (U. S. Sales Only).

The angular dependence of reaction products with a polarized beam and a polarized target exhibits some characteristics which do not depend upon the reaction mechanism but upon the particle and target spin values. A general description of a polarized beam is given. The properties of the reaction amplitudes with respect to the spins in the initial and the final states are studied, taking into account parity and time reversal invariances. Certain properties of the azimuthal distribution with respect to the incident beam, for the cross section and the polarizations of the outgoing particles are presented. The number of angular distributions which can be defined is a function of the spins. (France)

47042 (COO-3001-12) IMPORTANCE OF THE QUADRUPOLE PAIRING FIELD IN THE $J^\pi = 0^+$ VIBRATIONS OF SHAPE DEFORMED NUCLEI. Bes, D. R. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Los Alamos Scientific Lab., N. Mex.); Broglia, R. A. (State Univ. of New York, Stony Brook. Inst. for Theoretical Physics. Los Alamos Scientific Lab., N. Mex.); Nilsson, B. (State Univ. of New York, Stony Brook. Dept. of Physics). 1972. Contract AT(11-1)-3001. 16p. Dep. NTIS.

The monopole and quadrupole pairing residual interactions acting simultaneously on a system of particles which move in a set of Nilsson single-particle levels and which display a non-uniform distribution of positive and negative quadrupole moments around the Fermi surface give rise to BCS state dependent gaps, which can produce effects which are similar to those appearing when there is an energy gap in the single-particle spectrum. The competition between monopole and quadrupole pairing correlations allows for the existence of $J^\pi = 0^+$ pairing vibrations which carry large (p,t) cross sections and weak (t,p) cross sections or vice versa. This model is used in the analysis of the observed two-nucleon transfer data on the U-isotopes. (auth)

47043 (INDC-7-U, pp 3-19) EXCITATION ENERGY DEPENDENCE OF SHELL EFFECTS IN NUCLEAR FISSION. Kapoor, S. S. (Bhabha Atomic Research Centre, Bombay (India)).

From fourth meeting on neutron induced fission; Bombay, India (14 Jul 1971).

Some aspects of nuclear fission which are related to nuclear shell effects and their dependence on excitation energy are discussed. Properties of the fission barrier and the ground state deformation are analyzed. (J.W.R.)

47044 (INDC-7-U, pp 65-79) THEORY OF FRAGMENT MASS AND CHARGE DISTRIBUTION IN FISSION. Ramamurthy, V. S. (Bhabha Atomic Research Centre, Bombay (India)).

From fourth meeting on neutron induced fission; Bombay, India (14 Jul 1971).

A model for fission which assumes the preformation of fragments in the last stages of the division process is discussed. It is shown that with certain simplifying assumptions regarding the structure of single-particle levels in the nascent fragments, the observed mass and charge distributions for fission fragments as well as their dependence on the excitation energy of the fissioning nucleus may be explained. (J.W.R.)

47045 (INDC-7-U, pp 81-6) DISTRIBUTION OF THE TOTAL FISSION WIDTH. Ullah, Nazakat (Tata Inst. of Fundamental Research, Bombay (India)).

From fourth meeting on neutron induced fission; Bombay, India (14 Jul 1971).

Some recent developments in the distribution of the total fission width are presented. General expressions for the correlation coefficients of the resonance parameters which take into account the effects due to unitarity are given. A two-resonance two-channel model is used to derive an expression for the distribution of the total width. (auth)

47046 (INDC-7-U, pp 145-60) FISSION BARRIER HEIGHTS, ENERGY RELEASE, AND FRAGMENT ENERGY PARTITION PROCESSES FROM THE VIEWPOINTS OF THE NUCLEAR STRUCTURAL MODELS. Chatterjee, A. (Calcutta Univ. (India). Saha Inst. of Nuclear Physics, Calcutta (India)).

From fourth meeting on neutron induced fission; Bombay, India (14 Jul 1971).

Some recent theoretical work on various aspects of nuclear fission phenomena is briefly summarized. The work is mainly on the development of microscopic models to explain fission barrier heights, energy release, and fragment energy partition processes. (J.W.R.)

47047 (JINR-P2-6503) ACCOUNT OF NUCLEAR BOUNDARY DIFFUSIVITY IN THE INTRANUCLEAR CASCADE MODEL. Barashenkov, V. S.; Gudima, K. K.; Zheregi, F.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 9p. (In Russian). Dep. NTIS (U. S. Sales Only).

Taking into account the nuclear potential diffusivity and the density distribution of nuclear constituents in Monte-Carlo calculations is considered. This method does not use the division of the nucleus into spherical zones with constant density. The developed method corresponds to more realistic nuclear model and, at the same time, simplifies essentially the intranuclear cascade calculations, especially in the case of interactions of high-energy ions with nuclei. (auth)

47048 (JINR-P4-6452) POSSIBLE EXISTENCE OF SU(3) MULTIPLETS IN SPECTRA OF DEFORMED EVEN-EVEN NUCLEI. Raichev, P. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 15p. (In Russian). Dep. NTIS (U. S. Sales Only).

An assumption is made that the excited states of deformed even-even nuclei are combined into some SU_3 multiplets. The problem on the origin of these multiplets is discussed. (auth)

47049 (JINR-P4-6458) SU(3) PHYSICAL BASIS REALIZATION AND PROBABILITIES OF B(E2)-TRANSITIONS IN SU(3) SCHEME. II. Afanas'ev, G. N.; Avramov, S. R.; Raichev, P. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

The probabilities of transitions inside the rotational bands and between them are calculated in the framework of the SU(3) scheme. It is shown that there can be chosen the operators Ω_1 and Ω_2 separating sufficiently well the rotational bands. (auth)

47050 β,γ TRANSITIONS AND STRUCTURE OF ANTI-ANALOG STATES. Aleshin, V. P.; Kolomiets, V. M. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2368-73(Nov 1971). (In Russian).

The possibility of excitation and the structure of anti-analog configuration states and states with a polarized core are discussed in connection with $\beta\gamma$ processes. Electromagnetic transitions between anti-analog states and concomitant $T_<$-states in odd nuclei (N,Z + 1) are examined in shell models. (K.S.W.)

47051 REGULARITY IN MULTIPLET PROPERTIES OF ODD–ODD NUCLEI. Vorob'ev, V. D.; Peker, L. K.; Kharitonov, Yu. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2374-9 (Nov 1971). (In Russian).

A shell model was used to explain regularity in multiplet properties relative to a deformation of the multiplet with change in the number of particles in the shell. A large number of theoretical investigations which contained calculations of levels of odd–odd nuclei lead to the conclusion that the dominating influence in multiplet formation was the p–n pair interaction. Three isotopes with N = 127 were examined in the ^{208}Pd region: ^{212}At, ^{214}Fr, and ^{216}Ac, in addition to a number of Bi and Nb isotopes. Study of the ^{90}Zr region was confined to the isotopes ^{94,96}Nb. (K.S.W.)

47052 SPIN CORRELATION DURING BREMSSTRAHLUNG RADIATION OF LONGITUDINALLY POLARIZED ELECTRONS, ALLOWING FOR MULTIPOLE MOMENTS OF THE NUCLEI. Kerimov, B. K.; Sokolov, A. A.; El Gavkhari, A.; Ablakulov, Kh. A. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2380-5(Nov 1971). (In Russian).

The influence of a magnetic dipole moment of a nucleus with spin I on the transfer of spin of a longitudinally polarized electron during emission of circularly polarized bremsstrahlung had previously been studied. That result is here generalized for the case in which the electric quadrapole and magnetic octupole moments of the nucleus-target are considered. A formula was obtained which determined the effect of longitudinal polarization of a scattered electron and of multipole moments of the target-nucleus on the extent of circular polarization of decelerating protons. (K.S.W.)

47053 ISOTOPIC STRUCTURE OF THE GIANT DIPOLE RESONANCE AND THE ISOSPIN FREQUENCY IN THE GROUND STATE OF THE NUCLEUS. Kurlyandskii, A. S. Izv. Akad. Nauk SSSR, Ser. Fiz.; 35: No. 11, 2393-8(Nov 1971). (In Russian).

The excitation of analog states in the process of photoabsorption was studied. The particle-hole interaction in a channel leads to the formation of the giant dipole resonance in the cross section of photoabsorption. This process may be interpreted as the excitation of a "collective state" of a given particle-hole type. The isotopic structure of giant dipole resonance, and the isospin frequency are examined. (K.S.W.)

47054 VALIDITY OF DWBA FOR DEUTERON STRIPPING. I. THE MITRA THREE-BODY MODEL. Bouldin, D. P.; Levin, F. S. (Brown Univ., Providence). Nucl. Phys.; A189: No. 3, 449-71(1972).

Previous work showing that there exists an exact formulation of the DWBA for stripping in the S-wave, separable potential, three-body model of Mitra is discussed and extended. The one-body equation obeyed by the c.m. wave function used in the reformulated DWBA is derived and compared with the equation obeyed by the wave function used in the standard formulation of DWBA, viz., the deuteron elastic scattering wave function. Results obtained by other workers on application of three-body methods to direct reactions are discussed in light of the fact that an exact DWBA exists for the separable potential model. (auth)

47055 CHARGE-SYMMETRY BREAKING AND N–N SCATTERING LENGTHS. Henley, E. M.; Keliher, T. E. (Univ. of Washington, Seattle). Nucl. Phys.; A189: No. 3, 632-40(1972).

Recent experimental and theoretical investigations of $\rho-\omega$ and $\eta-\pi$ mixing have caused us to re-examine the effects of these mixings on the charge-symmetry breaking of nuclear forces. The charge asymmetry of the nucleon–nucleon force in the singlet S-state is used to predict the n–n scattering length in terms of the measured p–p one. The extra attraction of the n–n potential in the $^1S_0$ state gives rise to a change of roughly –0.8 fm in the corresponding scattering length. The magnitude (and sign) of the charge asymmetry is approximately that required to understand the binding-energy differences of the mirror nuclei ^{3}He–^{3}H and ^{41}Sc–^{41}Ca. (auth)

47056 HEAVY ION NUCLEAR REACTIONS. PHENOMENA INTERMEDIATE BETWEEN THE PHENOMENON OF THE COMPOUND NUCLEUS AND DIRECT TRANSFER EFFECTS. Basile, R. (Univ., Orleans, France); Galin, J.; Guerreau, D.; Lefort, M.; Tarrago, X. J. Phys. (Paris); 33: No. 1, 9-14(Jan 1972). (In French).

An exchange of nucleons is observed in heavy ion induced nuclear reactions in the very forward direction. It involves a deep nuclear interaction in which the nuclear matter is compressed. An attempt is given to explain this process using Coulomb potential, centrifugal barrier, Bruckner's attractive and repulsive nuclear potentials in the region (high nuclear density) where the projectile enters into the target nucleus. Transitory compound systems are formed when l is lower than a given value of h which depends on the energy (43h at 78 MeV, 54h at 100 MeV). By considering the number of excitons created in the area of interaction, it is found that for l lower than 37h, the number of excitons is large enough to carry a true compound nucleus process. A range of l value between 37 and 42h for 78 MeV (and between 46 and 53h for 100 MeV) yields a very short lived state which might explain the very inelastic cases of nucleon transfers. (France)

47057 CALCULATION OF THE NUCLEAR QUADRUPOLE MOMENT. Stamp, A. P. (Univ. of Auckland, New Zealand). Phys. Lett.; 33B: No. 4, 257-9(26 Oct 1970).

The single-particle configurations which must be taken into account to give reliable results for the calculation of quadrupole operators are determined. (auth)

47058 THEORY OF ANOMALIES OBSERVED IN (d,p) EXCITATION CURVES AT THRESHOLDS FOR NEUTRON ANALOGUE CHANNELS. Lane, A. M. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Phys. Lett.; 33B: No. 4, 274-8(26 Oct 1970).

It is shown that several essential features of the (d,p) threshold anomalies observed with targets $A \approx 90$ may be understood physically without elaborate calculations. In particular, their narrow width and their occurrence on threshold over the mass range 80–100 results from a remarkable energy compression effect operating on the single particle 3p-neutron state which is basically responsible for the anomaly. It is remarked that the wide variety of observed anomalies are classified very neatly by the Q-values of the (d,p) reactions. (auth)

47059 ISOSPIN DEPENDENCE OF OPTICAL MODEL POTENTIALS USING A REALISTIC EFFECTIVE INTERACTION. Sinha, B. C. (King's Coll., London). Phys. Lett.; 33B: No. 4, 279-80 (26 Oct 1970).

A linear iso-spin dependence of the optical model potential is found using a strong density dependent effective interaction. A correction, which depends on nuclear matter distribution, is suggested to the volume integral of the optical potential. (auth)

47060 SINGLE-PARTICLE SPIN–ORBIT POTENTIAL FOLLOWING FROM THE NUCLEON–NUCLEON SPIN–ORBIT INTERACTION. Penzel, R.; Stocker, W. (Univ., Munich). Nucl. Phys.; A190: No. 2, 218-28(1972).

The single-particle spin-orbit potential following from the nucleon–nucleon spin-orbit interaction is investigated for the case of a plane nuclear surface. Scheerbaum's result, that in the case when the triplet-even part of the spin-orbit interaction vanishes the exchange term is equal in first inhomogeneity order to the direct term, is verified. The second-order contribution to the exchange part is given explicitly. For a Gaussian form of the two-nucleon spin-orbit interaction it compensates partly for the first-order contribution, the ratio being about $-\frac{1}{3}$. The spin-orbit splittings following from the two-nucleon interaction of Green are calculated. (auth)

47061 SPECTROSCOPY WITH TWO-NUCLEON TRANSFER REACTIONS IN DEFORMED NUCLEI. I. FORM FACTORS. Ascuitto, R. J. (Yale Univ., New Haven); Soeresen, Bent. Nucl. Phys.; A190: No. 2, 297-308(1972).

A method for the evaluation of two-nucleon transfer form-factors is devised, which is suitable for the treatment of reactions between deformed nuclei. The nuclear-structure-dependent parts are evaluated in a rotating (intrinsic) frame. (auth)

47062 SPECTROSCOPY WITH TWO-NUCLEON TRANSFER REACTIONS IN DEFORMED NUCLEI. II. RARE-EARTH K = 0 BANDS STUDIES WITH THE (p,t) REACTION. Ascuitto, R. J. (Yale Univ., New Haven); Soeresen, Bent. Nucl. Phys.; A190: No. 2, 309-27(1972).

The ratio of the (p,t) strength to excited K = 0 bands relative to the ground band varies from a few to about 40% across the rare-earth region. This behavior is reproduced by a calculation that uses conventional pairing plus quadrupole interactions for the structure calculation and includes inelastic excitations in the treatment of the reaction. (auth)

47063 VERTEX PARAMETERS AND COUPLING CONSTANTS FOR THE VIRTUAL DECAY OF LIGHT NUCLEI. Rinat, A. S. (Weizmann Inst. of Science, Rehovot, Israel); Kok, L. P.; Stingl, M. Nucl. Phys.; A190: No. 2, 328-40(1972).

Various sources of information on vertex functions are compared. Explicit wave functions, scattering and reaction data, and dispersion relations are used to extract range parameters and spectroscopic factors of parametrized vertex functions describing the virtual decay of nuclei with $A \leq 6$. Mutual agreement is found in general, with the exception of the ^{6}Li–^{4}He-d vertex parameters. (auth)

47064 NUCLEON–NUCLEUS POTENTIAL IN THE HARTREE–FOCK APPROXIMATION WITH SKYRME'S INTERACTION. Dover, C. B. (Brookhaven National Lab., Upton, N. Y.); Nguyen Van Giai. Nucl. Phys.; A190: No. 2, 373-400(1972).

The connection between the self-consistent nuclear field in the Hartree–Fock (HF) approximation with the Skyrme interaction and the real part of the phenomenological nucleon–nucleus optical potential was investigated. It is shown that a simple local transformation $u(r) = (m^*(r)/(m)^{1/2}\, u^L(r)$ of the radial wave function u(r) leads to an ordinary Schroedinger equation for $u^L(r)$. The energy-dependent potential $V_L(r, E)$ which appears in this equation is identified with the real part of the nucleon optical potential. $V_L(r, E)$ is decomposed into a central part V_{av}, a symmetry part V_{sym} and a spin-orbit part $V_{s.o.}$. The radial form factors which characterize V_{av}, V_{sym} and $V_{s.o.}$ are expressed in closed form in terms of the total nuclear density $\rho(r)$ and the neutron excess density $\Delta\rho(r)$. Using force parameters obtained by fitting bound-state properties of closed-shell nuclei, V_L is calculated numerically and compared to empirical potentials. V_{av} strongly resembles a Woods–Saxon form, with depth $V_0 \approx -43$ MeV, radius $R_0 = 1.10A^{1/3} + 0.75$ fm and diffuseness $a \approx 0.55$ fm; V_{av} also contains an energy-dependent part of depth 0.43 E and radius $R_0^E = R_0 - 0.25$ fm. It is shown that V_{sym} is proportional to $\Delta\rho(r)$ times a smooth function of the density. The calculated symmetry potential changes from a surface form for medium nuclei (Ca) to a surface plus volume for heavier nuclei (Zr, Sn, Pb). The form factor for $V_{s.o.}$ is close to a Thomas form, but peaks at a radius inside that of the central potential. (auth)

47065 METHOD FOR SOLVING FADDEEV EQUATIONS. Benayoun, J. J. Gignoux, C. (Institut des Sciences Nucleaires, Grenoble, France). Nucl. Phys.; A190: No. 2, 419-36(1972).

Faddeev equations, written as coupled integro-differential equations, are solved by using a relaxation method. The initial guess solution for this method is obtained by solving Faddeev equations by means of separable expansions for two-body Green functions. This method is applied to the problem of the bound states for three bosons interacting via two potentials, one of them having a repulsive part. Preliminary results on the triton problem are given. (auth)

47066 SYSTEMATICS OF EXCITATION FUNCTIONS FOR FAST NEUTRON INDUCED (n,p)- AND (n,α)-REACTIONS. Krivan, V.; Muenzel, H. (Nuclear Research Centre, Karlsruhe, Ger.). J. Inorg. Nucl. Chem.; 34: No. 7, 2093-2108(Jul 1972).

The systematics of excitation functions for (n,p)- and (n,α)-reactions were investigated. The dependence of the position and value of the maximum cross-section, the half-width and an "asymmetry factor" on the charge number of the target material were evaluated from published data. Using these relationships, a procedure was developed for the construction of unknown excitation functions. To check this procedure, the activities produced by (n,p)-reactions with ^{27}Al, ^{51}V, ^{59}Co, ^{75}As and ^{103}Rh, and by (n,α)-reactions with ^{51}V, ^{75}As, ^{133}Cs and ^{165}Ho, were experimentally determined. The neutrons were obtained by bombarding a thick Be converter with 33 MeV and 53 MeV deuterons. Only for As do the determined activities deviate appreciably (by about a factor of two) from the values calculated with the aid of the calculated excitation functions. In all other cases the agreement was within 35%. (auth) (UK)

47067 TWO-PARTICLE ORBITAL MATRIX OF DENSITY FOR ONE-QUANTA OSCILLATORY-EXCITED SU_3-CONFIGURATIONS FOR p-NUCLEI. Kalinauskas, R. K.; Vanagas, V. V. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 11: No. 4, 581-93(1971). (In Russian).

In the case of one-quanta oscillatory-excited states of p-shell nuclei the decomposition of the unitary scheme wave function in terms of wave functions characterized by SU_3-configurations has been found. The explicit expressions for the spin-isospin independent two-particle matrix of density in space of SU_3-configurations for the maximum oscillatory energy for the relative motion of a pair of nuclei have been obtained. (auth)

47068 RESONANCE SCATTERING THEORY AND THE STRUCTURE OF COMPOUND STATES. Dumitrescu, O.; Kuemmel, H. (Ruhr Univ., Bochum, Ger.). Ann. Phys. (N. Y.); 71: No. 2, 556-68(Jun 1972).

A rigorous equation for compound-state wave functions (with only one channel open) is obtained. It is shown that the compound states may have a complex structure; however, this difficulty can be overcome using some solvable models. One such solvable model is proposed for the case of α decay. (auth)

47069 GENERATOR-COORDINATE FORM FACTORS FOR TRANSFER REACTIONS BETWEEN HEAVY IONS. Bonche, P.; Giraud, B. (CEN de Saclay, Gif-sur-Yvette, France). Phys. Rev. Lett.; 28: No. 26, 1720-3(26 Jun 1972).

In the framework of the distorted-wave Born approximation, a generator-coordinate formalism is used for optical waves. This results in a microscopic prescription for the calculation of transfer reaction form factors. A preliminary analysis of the reaction ^{54}Fe(^{16}O,^{12}C)^{58}Ni gives a reasonable fit to the angular distribution. (auth)

47070 SINGLE-PARTICLE EFFECTS ON FISSION PROBABILITIES FOR THE LIGHTER ELEMENTS. Vandenbosch, R.; Mosel, U. (Univ. of Washington, Seattle). Phys. Rev. Lett.; 28: No. 26, 1726-9(26 Jun 1972).

The excitation energy dependence of the competition between neutron emission and fission has been calculated for nuclei in the vicinity of the ^{208}Pb closed shell. A two-center model has been used to calculate single-particle effects on the nuclear level density as well as on the barrier heights. Comparison with experiment demonstrates the importance of including the dependence of the single-particle level density on deformation. (auth)

47071 NUCLEAR LEVEL SEQUENCE OF SINGLE-PARTICLE ENERGIES IN A MOMENTUM-DEPENDENT POTENTIAL. Lodhi, M. A. K.; Waak, B. T. (Texas Tech Univ., Lubbock). Phys. Rev. Lett.; 29: No. 5, 301-3(31 Jul 1972).

Single-particle energy calculations were made for nuclei from boron through beyond lead, a form of momentum-dependent nucleon–nucleus potential being used. The results are in good agreement with the observed data for energies of single-particle levels. (auth)

47072 LIMITS ON ANGULAR MOMENTUM IN HEAVY-ION–COMPOUND-NUCLEUS REACTIONS. Blann, M. (Univ. of Rochester, N. Y.); Plasil, F. Phys. Rev. Lett.; 29: No. 5, 303-6(31 Jul 1972).

Experimentally measured fusion excitation functions for the reactions induced on ^{27}Al with ^{16}O and on ^{107}Ag with ^{20}Ne are interpreted in terms of an equilibrium model with fission competition during de-excitation of the compound nucleus. The results of the calculation are in excellent agreement with experimental results—limits to angular momenta for nuclei surviving de-excitation of the compound nucleus are thereby predicted. (auth)

47073 COUPLED-CHANNEL CALCULATIONS OF THE ENERGY DEPENDENCE OF THE (p,n) CHARGE-EXCHANGE REACTION. Hoffmann, G. W.; Coker, W. R. (Univ. of Texas, Austin). Phys. Rev. Lett.; 29: No. 4, 227-9(24 Jul 1972).

Excitation functions of the (p,n$\bar{p}$) reaction on ^{91}Zr, ^{119}Sn, ^{208}Pb, and ^{209}Bi are compared with the predictions of exact solutions of the coupled Lane equations, and it is found that the distorted-wave Born-approximation and coupled-channel predictions have essentially the same overall shape if the same optical and symmetry potentials are used. A linear energy dependence of the complex symmetry potential, suggested earlier from distorted-wave Born-approximation analyses, as well as modification of the neutron optical potential are required to describe the available data from threshold to ~45 MeV if global optical parameters are used. (auth)

47074 SOLUTION OF THE BETHE–GOLDSTONE EQUATION IN FINITE NUCLEI FROM N–N PHASE SHIFT DATA. Hodgson, R. J. W. (Univ. of Ottawa). Can. J. Phys.; 50: No. 9, 940-6 (1 May 1972).

An approach is outlined wherein the Bethe–Goldstone wave function may be computed in a shell-model basis from a knowledge of the harmonic-oscillator matrix elements. These in turn may be derived from the N–N phase shifts by a number of different methods. The Pauli operator is treated exactly in the space of two-particle shell-model states. The method is applied to a calculation of the levels of ^{18}O and ^{18}F and results obtained using different two-body matrix elements are compared. (auth) (Canada)

47075 TRANSFER REACTIONS TO UNBOUND STATES BY THE DIFFRACTION MODEL. Sharaf, M. A. (International Centre for Theoretical Physics, Trieste, Italy). Z. Phys.; 253: No. 1, 28-37(1972).

Transfer reactions leading to unbound states are studied by means of the diffraction model. The unbound state is described by a resonance scattering wave function. The radial integrals are evaluated using some reasonable approximations. Comparison with the experimental results is very satisfactory. (auth)

47076 QUASI-CLASSICAL TREATMENT OF MULTINUCLEON TRANSFER REACTIONS. Toepffer, Christian (Univ., Frankfurt am Main). Z. Phys.; 253: No. 1, 78-88(1972).

The surface nature of the transfer reaction and the quasi-classical relative motion of the nuclei imply strong conditions on optimal scattering angles and Q values. These are evaluated using the method of stationary phases. Recoil effects are considered. The agreement with experiment is good. (3 figures, 1 table) (auth)

47077 CONSIDERATION ON DIRECT REACTION MECHANISMS IN THE UNIFIED MICROSCOPIC NUCLEAR THEORY. Hub, R.; Clement, D.; Wildermuth, K. (Univ., Tuebingen, Ger.). Z. Phys.; 252: No. 4, 324-48(1972).

In the framework of a unified microscopic nuclear theory the starting equations for the discussion of the different phenomenological direct reaction theories are derived. Subsequently the ^{6}Li(p,^{3}He)^{4}He reaction is discussed as a realistic example to obtain a better physical insight into the different kinds of reaction mechanisms. (10 figures, 1 table) (auth)

47078 REPULSIVE CORE EFFECTS IN (t,p) STRIPPING REACTIONS. Osman, A.; Zimanyi, J. (Central Research Inst. for Physics, Budapest). Lett. Nuovo Cim.; 4: No. 7, 246-50 (17 Jun 1972).

The effect of the repulsive core in the nucleon-nucleon interaction on (t,p) stripping reactions was analyzed. The effect was found to be a small constant multiplicative factor relative to the nonrepulsive case. (J.W.R.)

47079 ALPHA INTENSITIES TO ROTATIONAL BANDS OF ODD-A NUCLEI. Sharma, R. C. (Sir George Williams Univ., Montreal). Lett. Nuovo Cim.; 4: No. 7, 257-61(17 Jun 1972).

The total probability for exciting a rotational level in a daughter nucleus with spin J, after the emission of an alpha particle with angular momentum l, was calculated for 22 odd-A nuclei from A = 227 to 257 using the formula of Nosov. Deviations between the calculated and experimental values are discussed. (J.W.R.)

47080 ANALYSIS OF EXPERIMENTAL ENERGIES OF EXCITED STATES OF EVEN-EVEN DEFORMED NUCLEI USING ROTATIONAL FORMULAS. Abdurakhmanov, S. R.; Belen'kii, V. M. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 5, 66-9(1971). (In Russian).

The empirical formula of Y. P. Varshni (1968) was used to analyze known experimental values for energies of excited states of rotational bands from even-even deformed nuclei in the region $150 < A < 190$ and $A > 220$. The results from over 40 nuclei were compared with those of an analogous analysis using the formula of Bohr and Mottelson (1963), and it was concluded that Varshni's formula represented the experimental values more accurately. A simple criterion was obtained for excluding incorrect experimental energies of excited states with a given spin. (K.S.W.)

47081 COLLECTIVE-SINGLE-PARTICLE STATES OF DEFORMED ODD NUCLEI. Begzhanov, R. B.; Salakhitdinov, A. N.; Sharipov, Sh. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 5, 76-9(1971). (In Russian).

The same authors had previously examined excited states of odd, nonspherical atomic nuclei on the basis of a phenomenological model of the odd nucleus. New calculations have now been made on odd nuclei, with a basic state spin of $^{7}/_{2}$, and allowing for nuclear deformation. The theory yielded results for the isotopes ^{165}Ho and ^{253}Cf which agreed very well with experimental values. (K.S.W.)

47082 ROLE OF THE EXIT STATES OF A COMPOUND NUCLEUS IN THE EMISSION OF HIGH-ENERGY γ-RAYS. Brzosko, J. S.; Piotrowski, J.; Soltan, A. Jr.; Szeflinski, Z. (Univ., Warsaw). Nucl. Phys.; A189: No. 3, 545-55(1972).

An explanation is proposed for the appearance of the bump in γ-spectra emitted by nuclei excited to 10 MeV in the (n,γ), (p,γ) and (γ,γ') reactions. The study is based on a previous analysis which indicated that decay of the compound nucleus is responsible for this phenomenon. It has been assumed that the main mode of the compound-nucleus decay is an exit state consisting of a highly excited nucleon and a low excited core. The estimates carried out reproduce the characteristic features of the phenomenon studied. (auth)

47083 ALPHA-CLUSTER STRUCTURE AND WEAK COUPLING FEATURE IN LIGHT sd-SHELL NUCLEI. GENERAL DISCUSSION AND ^{19}F PROBLEM. Nemoto, Fumiki; Bando, Hiroharu (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 47: No. 4, 1210-34(Apr 1972).

With the aim to investigate the core excited states in nuclei from ^{20}Ne to ^{16}O*, an α-cluster model is presented which can be applied to non α-nuclei. Both alpha-clustering and overall antisymmetrization are found to be important to reproduce the weak α-hole repulsion, which is responsible for weak coupling features and other trends of the core excited states observed in these nuclei. The nucleus ^{19}F(^{19}Ne) is treated especially in detail and it is shown that the observed weak coupling behavior is understood consistently within this model. (auth)

47084 (44) AND (60) + (06) INTERACTIONS IN THE s-d SHELL. Taruishi, Koji (Tokyo Metropolitan Univ.). Progr. Theor. Phys. (Kyoto); 47: No. 4, 1422-3(Apr 1972).

The expansion of Slater integrals in terms of Talmi integrals is discussed. Two equations are given as an example of direct integrals reducing to a sum of several integrals with different Legendre polynomial orders. Expansion coefficients are calculated for the (44) and (60) + (06) interactions. (J.W.R.)

47085 (N-Z) DEPENDENCE OF (n,γ) CROSS SECTIONS. Matsuoka, Kazuo (Osaka Univ.); Isomoto, Yukuo; Sano, Mituo; Igarasi, Sin-iti; Nishimura, Kazuaki Progr. Theor. Phys. (Kyoto); 47: No. 4, 1428-30(Apr 1972).

Cross sections for (n,γ) reactions above resonance energies have been observed to decrease gradually with increasing neutron excess. Exceptions were found for magic neutron numbers and for nuclei in the transition region. Origins for these characteristics are discussed. The N-Z dependence of the neutron separation energy and the shell effect for the level density are two reasons for these characteristics. (J.W.R.)

47086 PROBLEMS OF MODERN NUCLEAR PHYSICS. Proceedings of the Second Problem Symposium on Nuclear Physics, Novosibirsk, USSR, June 12-19, 1970. Kolybasov, V. M. (ed.). Moscow; Izdatel'stvo Nauka (1971). 544p. (In Russian and English). (CONF-700635).

Separate abstracts were prepared for 23 of the 30 complete papers included. Abstracts for the remaining 7 papers have previously appeared in NSA. (J.W.R.)

For abstracts of individual papers see: 46644, 46658, 46869, 46870, 46890, 46891, 46914, 47008, and 47087-47101.

47087 INTEGRAL EQUATIONS OF SCATTERING THEORY AND FEW-NUCLEON SYSTEMS. Faddeev, L. D. pp 5-19 of Problems of Modern Nuclear Physics. /Kolybasov, V. M. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

From 2. symposium on the problems of nuclear physics; Novosibirsk, USSR (12 Jun 1970).

Two circumstances simplify the application of accurate integral equations of scattering theory to few-nucleon systems: the small radius of inter-nucleon interaction and the fact that only one value exceeds unity for two or for three particles. After introducing the desired integral equations, three methods are given for solving them (Gilbert-Smith, Bateman, and the unitary polar approximation, UPA). The review continues with characteristics of three spinless bosons, three-nucleon systems, and a discussion of theoretical results by selected authors. (55 references) (K.S.W.)

47088 BOUND STATES OF FEW-NUCLEON SYSTEMS. Badalyan, A. M. (Inst. of Theoretical and Experimental Physics, Moscow). pp 20-30 of Problems of Modern Nuclear Physics. /Kolybasov, V. M. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

From second symposium on the problems of nuclear physics; Novosibirsk, USSR (12 Jun 1970).

Calculations of various characteristics for bound states of few-nucleon systems were made under different conditions: pair potentials at small distances, without tensor forces, etc. A K-harmonic method was used for 3- and 4-particle systems Darevich-Green potentials, and Woods-Saxon potentials were also used in treating the data. (K.S.W.)

47089 RECENT EXPERIMENTS ON THE FOUR AND FIVE NUCLEON SYSTEMS. Meyerhof, W. E. (Stanford Univ., Calif.). pp 30-49 of Problems of Modern Nuclear Physics. /Kolybasov, V. M. (ed.). Moscow; Izdatel'stvo Nauka (1971).

From second symposium on the problems of nuclear physics; Novosibirsk, USSR (12 Jun 1970).

Some recent experiments on four and five-nucleon systems are reviewed. Theory and experiment are compared for some of the data. (J.W.R.)

47090 HYPERSPHERICAL HARMONICS METHOD IN THE THEORY OF NUCLEAR BOUND STATES. Simonov, Yu. A. (Inst. of Theoretical and Experimental Physics, Moscow). pp 51-78 of Problems of Modern Nuclear Physics. /Kolybasov, V. M. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

From second symposium on the problems of nuclear physics; Novosibirsk, USSR (12 Jun 1970).

The method of multidimensional harmonics is described, and basic equations and physical premises of the method are given with some properties of their solution. A method is given for calculating matrix elements, and for extending the calculations to wave functions with $K = K_{min} + 1$ and $K_{min} + 2$. The results allow an insight into the spectrum of excited states, and the addition of higher harmonics to the basic state. The problem of saturation is discussed in the framework of the present method, and the latter is related to other approaches in the theory of the nucleus. (K.S.W.)

47091 USE OF THE K-HARMONICS METHOD TO CALCULATE NUCLEAR PROPERTIES. Baz, A. I. (Inst. of Atomic Energy, Moscow). pp 79-102 of Problems of Modern Nuclear Physics. /Kolybasov, V. M. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

From second symposium on the problems of nuclear physics; Novosibirsk, USSR (12 Jun 1970).

A number of theoretical schemes resulted from the application of the K-harmonics method to the calculation of some basic properties of the nucleus. The general formula of the K-harmonics method is elucidated, and a fundamental approximation is given to assist in its practical use. The calculation of matrix elements between the K-harmonics is explained, and a shell model is introduced which was utilized in the calculation of nuclear spectra. (K.S.W.)

47092 COLLECTIVE LOW-LYING NUCLEAR STATES. Belyaev, S. T. (Inst. of Nuclear Physics, Novosibirsk, USSR). pp 129-41 of Problems of Modern Nuclear Physics. /Kolybasov, V. M. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

From second symposium on the problems of nuclear physics; Novosibirsk, USSR (12 Jun 1970).

Low excited states of even-even nuclei (<2.5 to 3 MeV) generally possess a collective nature. Phenomenological and microscopic models are briefly discussed, and two models for coupling nucleons at two levels were employed in a theoretical calculation of spectra and energies of excited states for comparison with experimental curves. A method for examining (quasi) rotational excitation is divded into several steps: selection of groups of states interfering strongly among themselves but relatively weakly connected with other states, the establishment of symmetry and quantum numbers of collective states, and the solution of equations for density matrices in generalized space. (K.S.W.)

47093 COMPARISON OF VARIOUS APPROACHES TO NUCLEAR THEORY. Migdal, A. B. (Inst. of Atomic Energy, Moscow). pp 157-66 of Problems of Modern Nuclear Physics. /Kolybasov, V. M. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

From second symposium on the problems of nuclear physics; Novosibirsk, USSR (12 Jun 1970).

The nucleus is first treated as a multi-body problem with excitation theory and the so-called gaseous approximation outlined as the simpler approximative approaches. The "microscopic" approach to nuclear theory, beginning with the interaction of two nucleons in a vacuum, is developed, and the basic ideas relating to the quasiparticle method are presented. (K.S.W.)

47094 CRITICAL EXPERIMENTS FOR DETERMINING PARAMETERS OF EFFECTIVE PARTICLE INTERACTION IN A NUCLEUS. Sliv, L. A. (Ioffe Inst. of Physics and Tech., Leningrad). pp 188-200 of Problems of Modern Nuclear Physics. /Kolybasov, V. M. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

From second symposium on the problems of nuclear physics; Novosibirsk, USSR (12 Jun 1970).

It is assumed that the effective interaction in the nucleus is analogous to the interaction between free nucleons, with basic members of the effective interaction being central, tensor, spin-orbital, and quadratic in L. Theoretical treatment is accorded to each of these topics. (K.S.W.)

47095 THEORY OF LOW-LYING NUCLEAR STATES IN THE SCHEME $U_{3(A-1)}$. Vanagas, V. V. (Inst. of Physics and Mathematics, Vilnyus, USSR). pp 201-18 of Problems of Modern Nuclear Physics. /Kolybasov, V. M. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

From second symposium on the problems of nuclear physics; Novosibirsk, USSR (12 Jun 1970).

The properties of low-lying levels of nuclei were investigated with the help of a model representation based solely on the kinematic properties of the nuclear wave function. The fundamental development of the model which was based on the scheme of the unitary group $U_{3(A-1)}$ is reviewed. Following this development the unitary scheme is related to properties of real nuclei. The operator for potential energy of the nucleus is expanded through group operators, which leads to the general properties of the spectrum of the operator for the potential energy of the nucleus. (K.S.W.)

47096 PROGRESS IN THE THEORY OF NUCLEAR MATTER AND ITS APPLICATION TO FINITE NUCLEI. Negele, J. W. (Univ. of Copenhagen). pp 218-43 of Problems of Modern Nuclear Physics. /Kolybasov, V. M. (ed.). Moscow; Izdatel'stvo Nauka (1971).

From second symposium on the problems of nuclear physics; Novosibirsk, USSR (12 Jun 1970).

The physical foundations of nuclear matter theory are discussed. It is shown how the present knowledge of nuclear matter enables one to understand the ground-state properties of finite nuclei. Some of the criticisms of nuclear matter theory are answered. (J.W.R.)

47097 COULOMB ENERGIES AND NUCLEAR RADII. Schiffer, John P. (Argonne National Lab., Ill. Univ. of Chicago). pp 246-55 of Problems of Modern Nuclear Physics. /Kolybasov, V. M. (ed.). Moscow; Izdatel'stvo Nauka (1971).

From second symposium on the problems of nuclear physics; Novosibirsk, USSR (12 Jun 1970).

Empirical Coulomb energy differences and charge radii were used to extract a mean-square radius for the neutron excess in a number of nuclei. The calculations were restricted to closed proton shells in order to avoid complications arising from uncertainties in configurations. The results are discussed and compared with other results. (J.W.R.)

47098 OVERLAPPING LEVELS AND GIANT RESONANCES. Shapiro, I. S. (Inst. of Theoretical and Experimental Physics, Moscow). pp 273-84 of Problems of Modern Nuclear Physics. /Kolybasov, V. M. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

From second symposium on the problems of nuclear physics; Novosibirsk, USSR (12 Jun 1970).

The concept of the input state is formulated, not being based on model representation. The phenomenological theory of giant nuclear resonances is subsequently developed, and related to the dynamics of the formation of a composite nucleus. (tr-auth)

47099 SPECTROSCOPIC STUDIES WITH ISOBARIC ANALOG RESONANCES. von Brentano, Peter (Max-Planck-Institut fuer Kernphysik, Heidelberg). pp 285-318 of Problems of Modern Nuclear Physics. /Kolybasov, V. M. (ed.). Moscow; Izdatel'stvo Nauka (1971).

From second symposium on the problems of nuclear physics; Novosibirsk, USSR (12 Jun 1970).

The spectroscopic information obtainable from isobaric analog resonances is described. Methods for analyzing experimental data on these resonances are reviewed. The S-matrix for isobaric analog resonances is discussed in detail. Some experimental data is surveyed. (J.W.R.)

47100 DESCRIPTION OF THE INTERACTION OF HIGH ENERGY PARTICLES WITH NUCLEI. Feshbach, H. (Massachusetts Inst. of Tech., Cambridge). pp 379-91 of Problems of Modern Nuclear Physics. /Kolybasov, V. M. (ed.). Moscow; Izdatel'stvo Nauka (1971).

From second symposium on the problems of nuclear physics; Novosibirsk, USSR (12 Jun 1970).

Some quantitative reasons for errors in the diffraction model due to correlations are given. An alternate formalism for the description of the scattering of high energy particles by nuclei is offered. (J.W.R.)

47101 MECHANISM OF DIRECT PROCESSES AT HIGH ENERGIES. Kolybasov, V. M. (Inst. of Theoretical and Experimental Physics, Moscow). pp 391-410 of Problems of Modern Nuclear Physics. /Kolybasov, V. M. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

From second symposium on the problems of nuclear physics; Novosibirsk, USSR (12 Jun 1970).

The wide variety of nuclear reactions are discussed with respect to possible mechanisms: inelastic collisions A(x,x')A*, knock-out reactions A(x,x'y)B, the polar mechanism A + x → B + y + z, the decay reaction A → B + i, etc. The discussion touches upon polarization effects, verification of isotopic ratios, differential cross sections, and angular distribution of proton paths in reactions emitting protons. (K.S.W.)

47102 THEORETICAL INVESTIGATION OF COLLECTIVE EXCITATIONS IN MEDIUM AND HEAVY NUCLEI. Das, Tapan Kumar. Philadelphia; Univ. of Pennsylvania (1971). 163p. University Microfilms Order No. 72-17,342.

Thesis.

The collective excitations in medium and heavy doubly even nuclei have been investigated by examining a few phenomenological models. Attempts have also been made to understand the nuclear rotations and vibrations on a uniform footing by providing theoretical foundations of some of the phenomenological models. A theoretical foundation as well as a higher order generalization for the highly successful Variable Moment of Inertia (VMI) model have been provided utilizing the variation after projection (VAP) method. The derivation gives a theoretical justification for the applicability of the model outside the strongly deformed region. By analogy, a variable frequency (VF) model is obtained for one dimensional vibrations. Extending the ideas, a multi-band VMI-VF model has been proposed and successfully applied to the available

data. The multi-band VMI model has been shown to reduce to the form of the original VMI model for the excitation energy with respect to the band head of a given band. This indicates that the effects of band mixing are already incorporated in the original VMI model. The ground state bands have also been investigated in terms of the Harris or generalized cranking model. It has been proved that this model is exactly equivalent to the generalized VMI model, when all orders are taken. As an independent foundation of the model, a derivation of the cranking variational equation (CVE) for a two dimensional case was performed. Next an approach to the problem starting from the vibrational end is made by proposing a model of anharmonic vibrations (AVM). The AVM has been applied to the ground state bands. This gives a power series in angular momentum quantum number for the excitation energy of members of the band. It has been shown that this series converges in the rotational limit, when successive pairs of terms of the series are considered. This model has been applied to the available data for the excitation energies and B(E2) values of members of the ground state band. Finally an attempt has been made to generalize the AVM description to include excited bands. A complete set of computing operators has been found for complete classification of the states in the vibrational description. To apply the generalization to the excited rotational bands, one needs to discover a correlation between the two sets of quantum numbers specifying the vibrational and rotational descriptions. An attempt in this direction met with no success indicating that no such simple correlation exists. (Diss. Abstr. Int., B)

47103 NUCLEAR THREE-BODY PROBLEM AND GENERALIZED SPHERICAL HARMONICS. Schneider, Thomas Richard. Philadelphia; Univ. of Pennsylvania (1971). 193p. University Microfilms Order No. 72-17,421.

Thesis.

A scheme for solving the three-body bound state problem by expanding the wavefunction in a complete set of generalized spherical harmonics is presented. This reduces the three-body Schroedinger equation to an infinite set of coupled ordinary differential equations in one variable. Restricting the problem to a finite subspace the convergence properties of this approximation as the number of states increases is dealt with. These states are labeled by the eigenvalues of the operator Λ^2. The corresponding classical operator is zero only when all three particles are at the same point in space at the same time, and thus is a measure of the "compactness" of the system. The convergence problems associated with the expansion are related to the Fourier problem. A theorem about the convergence rate of generalized Fourier series is proved. Combining this with theorems on the convergence of the approximate energies and wavefunctions gives one the asymptotic convergence rate of the binding energies. Examining the properties of the Schrödinger equation, one can relate the convergence rate to the properties of the two-body potential. The approximate energies converge as inverse powers of the eigenvalues of Λ^2, with the power depending upon the exact form of the two-body potential. Some calculations of the binding energies of three-boson systems are presented. These calculations are performed, with potentials of both Yukawa and square well form, by numerically integrating the coupled differential equations. Even potentials with repulsive Yukawa cores can be easily solved using generalized spherical harmonics. (Diss. Abstr. Int., B)

PHYSICS (PLASMA AND THERMONUCLEAR)

47104 PLASMA: THE FOURTH STATE OF MATTER. Frank-Kamenetskii, D. A. New York; Plenum Publishing Corporation (1972). 165p. $12.50.

Translation of Plazma: Chetvertoe Sostoyanie Veshchestva by Joseph Norwood Jr.

The fundamental concepts of plasma physics are discussed without relying on intricate mathematics. The magnetohydrodynamics, as well as the physical kinetics of plasma, are described. Plasma oscillations, instability, compression, and confinement by magnetic fields are discussed in a very elementary manner. (M.O.W.)

Confinement and Heating

47105 VISCOSITY AND THERMAL CONDUCTIVITY EFFECTS ON THE CONTAINMENT OF A TOROIDALLY CONFINED RESISTIVE PLASMA WITH FLOW. Grimm, R. C.; Johnson, J. L. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Plasma Phys.; 14: No. 6, 617-34(Jun 1972).

Plasma containment in toroidal systems is studied using a fluid model containing the effects of plasma inertia, resistivity (electron–ion momentum transfer), viscosity (ion–ion collisions), and thermal conductivity. Asymptotic expansion techniques are used to separate the problem into two distinct parts—determination of steady-state configurations where time variations occur only on a diffusion time scale, and investigation of the stability of these equilibria. The previously known steady-state solutions are shown to be stable. However, terms in the stress tensor associated with the curvature of the magnetic field lines, which introduce parallel viscosity into the components of the momentum equation perpendicular to the field, are shown to restrict the possible solutions. (auth)

47106 NONADIABATIC ENERGY LIMIT VERSUS MIRROR RATIO IN MAGNETIC-WELL GEOMETRY. Foote, James H. (Univ. of California, Livermore). Plasma Phys.; 14: No. 5, 543-52(May 1972).

The energy at which ions trapped in a static quadrupole magnetic well begin to exhibit nonadiabatic behavior in their single-particle motion was determined for mirror ratios from 1.4 to 8.1. The analyzed data are derived partly from digital-computer orbit calculations and partly from experiment. The investigated particles either reflect at closed contours of constant magnetic-field magnitude or are constrained by the field lines to reflect in regions where the contours approximate sections of closed magnetic-field surfaces. The calculated trajectories pass through the central region of the well and represent the first trapped particles in a closed-contour system to become nonadiabatic as the energy is increased. (UK)

47107 COLLISIONLESS HEATING OF A PLASMA BY MEANS OF OSCILLATING EXTERNAL CURRENTS. Lashmore-Davies, C. N. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Plasma Phys.; 14: No. 4, 357-66(Apr 1972).

The transfer of power between an external circuit and a collisionless plasma is described. A very simple model is used that enables heating for arbitrary values of the frequency to be analyzed. Transit-time magnetic pumping and ion-cyclotron heating are described in detail. The simple model used enables the mechanism of magnetic pumping to be described much more precisely than has been done previously. (UK)

47108 HEATING OF TOROIDAL PLASMAS BY NEUTRAL INJECTION. Stix, Thomas H. (Princeton Univ., N. J.). Plasma Phys.; 14: No. 4, 367-84(Apr 1972).

A brief review of the physics of ion acceleration, charge exchange and ionization, trajectories for fast ions in toroidal magnetic fields, and fast-ion thermalization is presented. The injection of fast atoms is found to be a highly competitive method both for heating present-day experimental toroidal plasmas and for bringing full-scale toroidal CTR plasmas to low-density ignition. (auth)

47109 PLASMA HEATING NEAR THE ION-CYCLOTRON FREQUENCY AND ITS HARMONICS. Clark, Reginald Wayne. Austin, Tex.; Univ. of Texas (1971). 134p. University Microfilms Order No. 72-19,570.

Thesis.

Additions are made to the theory of the quasi-ion Bernstein modes that propagate for wave frequencies near the harmonics of the ion cyclotron frequency, and experience ion cyclotron damping as the harmonic resonances are approached. The effects of collisions and electron Landau damping are included, and group-velocity calculations are performed. When the effects of collisions are included, the theory predicts strong collisional damping in high-density, low-temperature collision-dominated plasmas, whereas the original theory predicted wave propagation in the absence of collisions. The inclusion of electron Landau damping effects in the theory modifies the propagating bands so that the waves propagate undamped only in narrow bands near cutoff, i.e., where the component of the propagation vector parallel to the magnetic field is small. The ion acoustic–electrostatic ion cyclotron (IA–EIC) wave also propagates near the fundamental and in bands near harmonics of the ion cyclotron frequency but requires for weak ion and electron Landau damping that $T_e > T_i$, which is an undesirable temperature condition for plasma heating. However, due to nonlinear effects, the constraints imposed by electron Landau damping considerations may not be important for large-amplitude waves. The constraints imposed by ion Landau damping, however, remain valid over much longer times and distances than those imposed by the electrons and hence represent much stronger constraints. An experimental investigation of harmonic ion cyclotron wave propagation in high-density, low-temperature collisionally dominated plasma indicates that the waves are very heavily damped. These results indicate that a high-density plasma must be preheated to a temperature where collisions become unimportant before harmonic ion cyclotron waves can be used for plasma heating. Subsequent experimental investigation of heating in the turbulently preheated plasma in the Cornell University THM-2 plasma machine indicates plasma heating at densities as high as $\sim 7 \times 10^{18}/m^3$. Ion energy measurements indicate ion temperatures the order of 100 to 110 eV and a nonMaxwellian energy distribution with a higher-energy tail, while diamagnetic loop measurements indicate that the sum of the ion and electron temperatures is roughly between 100 and 200 eV. Interferometer measurements indicate that the plasma is contained for the duration of the 600-μsec rf pulse. Fluctuations were observed that are attributed to particles bunching and executing longitudinal oscillatory motion between the magnetic mirrors of the THM-2. These observations raise the possibility that the heating resulted from the nonlocal resonance that may arise when particles oscillate in an inhomogeneous magnetic field. The observed heating was proportional to the net power input, and no saturation effects were seen. The overall energy-transfer efficiencies are estimated to be at least 20 to 40%. (Diss. Abstr. Int., B)

47110 PLASMA INJECTION AND COLLISION PHENOMENA IN AN OCTUPOLE MAGNETIC FIELD. Ligon, Jerry Lloyd. Austin, Tex.; Univ. of Texas (1971). 182p. University Microfilms Order No. 72-19,624.

Thesis.

This work investigates the transverse plasma injection into a linear octupole magnetic field by using two colliding plasmas for injection instead of the usual single plasma. The two plasmas enter the octupole field from opposite sides and collide at selected locations in the field region. The theory that applies to plasma injection and collision in a transverse magnetic field is presented, and the possible effects of Coulomb collisions, collective instabilities, and polarization electric fields are discussed. Expected results from a typical experiment are also presented. A computer simulation of two-plasma injection into a magnetic field similar to the octupole field is carried out. The program is a modification of a program written for analysis of single gun injection. The results of the program agree with the experimental results in describing some aspects of the injection and interaction. (TSS) (Diss. Abstr. Int., B)

47111 PARALLEL MAGNETIC MULTIPOLE CONFINEMENT OF A MAGNETIC-FIELD-FREE PLASMA. Limpaecher, Rudolf. Los Angeles; Univ. of California (1972). 105p. University Microfilms Order No. 72-20,454.

Thesis.

A new multimagnetic mirror plasma device is described. The walls of this cylindrical 86-liter "box" are lined with 1252 ($\frac{1}{2}'' \times \frac{1}{2}'' \times 1.5''$) ALNICO V permanent magnets to form a series of parallel broken-line cusp geometry. Since the magnetic field falls off exponentially ($\delta \cong 1.2$ cm) the interior is essentially magnetic field free, even though B_{max} (at the walls) is 1800 gauss. The argon, helium, hydrogen, or deuterium plasma is produced by electron emission from 12 short tungsten filaments with an emission current of $0 < I_{ee} \leq 5A$ over a neutral density range of $5 \times 10^{-6} \leq n_0 \leq 2 \times 10^{-3}$ torr and a plasma density of over 2×10^{11} cm^{-3} torr. For argon and helium the empirical relation $n \propto$

$n_0^{0.33\pm0.05}I_{ee}$ is found over the neutral density and emission current range specified. A plasma nonuniformity of less than 1% is recorded in the magnetic field-free region with a plasma noise level of $\delta n/n = 3 \times 10^{-4}$. A steady-state plasma lifetime of over 20 msec is obtained. The system ionization efficiency is particularly impressive. With a total input power of 500 watts (heater and emission) the device has a volume of 10^{13} Debye spheres, where 4×10^{13} particles per watt of input power are maintained in the steady-state condition. At 5×10^{-6} torr, a fractional ionization of 35% is obtained. Strong evidence exists that the ions are contained magnetically as well as electrostatically. The electrostatic fields, which are maintained by the plasma electron and emission electron interaction with the magnetic multipole field, drastically reduce the ion cusp losses. With this multipole structure, high density quiescent collisionless plasmas can be produced with any size and any geometry. An obvious extension is the application of a uniform magnetic field for high-beta experiments. A new system is proposed to contain high energetic ions by replacing internal emission electron sources by electron beams. These electrons have to be injected through the central cusp regions of the electromagnets. (Diss. Abstr. Int., B)

47112 TURBULENT HEATING OF THE IONS IN A TOROIDAL DISCHARGE. Mah, Seck Qui. Saskatoon, Saskatchewan; Univ. of Saskatchewan (1971). 173p. University Microfilms Order No. 72-18,654.

Thesis.

Studies of plasma heating were carried out in a toroidal, high-voltage discharge. The argon plasma of density $\sim 10^{19}/m^3$ is formed initially by rf preionization at low pressure (≈0.3 mtorr). The electric field (~5 kV/m) of the main discharge is applied parallel to a steady, toroidal magnetic field (≤0.2 Wb/m^2). Rapid ion heating, to $\sim 10^{5}$°K, is observed in the time interval from 1 to 2 μsec after initiation of the electric field. The ion temperature is determined from the Doppler broadening of the Ar II 4806-Å emission using a time-resolved, single-channel Fabry-Perot interferometer with piezoelectric scanning. Ion acoustic waves induced by the electron current during the discharge are shown to be the probable cause of the rapid heating. This conclusion was reached by measuring, in addition to the ion temperature, the electron temperature, electron density, plasma current and electric field, all as a function of time. The measurements show that, when rapid ion heating is observed, the electron drift velocity is above the critical value for growth of ion acoustic waves and, more significant, the rapid heating ceases when the mean electron velocity falls below this critical value. Anomalously low electrical conductivity is observed in the interval when the ions are rapidly heated. The observed conductivity is about two orders of magnitude lower than classical, indicating a large collision frequency between electrons and the waves excited in the plasma. Detailed comparison with the conductivities predicted by theories of plasma turbulence due to the ion acoustic instability show that these cannot provide a satisfactory explanation. Partial agreement is found between experiment and the theory of Dupree. At the onset of the high-voltage discharge, electrons are heated rapidly, up to several times 10^{7}°K, within a fraction of a microsecond. Only a small portion of the input energy is converted into particle drift; the rest goes into electron heating. Energy accounting is not possible at later times in the discharge, where rapid electron cooling due to some unknown process is observed. (Diss. Abstr. Int., B)

47113 ELECTROSTATIC CONTAINMENT IN FUSION REACTORS. Hirsch, Robert L. (to International Telephone and Telegraph Corp.). U. S. Patent 3,664,920. 23 May 1972. Filed 21 Jun 1968.

Apparatus is described for producing controlled nuclear-fusion reactions. A generally circular cathode has concentrically positioned therein a generally circular anode having multiple openings for the free flow of electrons. The anode encloses a volume free of tangible structure. An electron-emissive electrode in the interelectrode space between the anode and cathode emits electrons which penetrate the anode and enter the central volume, establishing a negative space charge. Ions of a fusion reacting gas are injected at a location within the volume, at a potential less than that applied to the anode, and are focused toward a common cross-over point in the central portion thereof. The magnitude of the negative space charge as well as the energies of the ions introduced into the volume are so controlled that collisions of the ions at or near the cross-over point result in the fusing thereof. Electrons introduced in the interelectrode space traverse the cathodic space, thereby making a number of trips through the anode. In this invention, the anode structure is effectively shielded such that electron interception thereby with consequent high energy electron losses can be made to approach zero. This is accomplished by creating a magnetic field around the portions of the anode which define the openings, this field serving to shield the conducting portions thereof. (Official Gazette)

47114 PLASMA CONFINEMENT BY EXTERNAL RF SIGNAL. Chiplonkar, V. T.; Sapre, A. V. (Inst. of Science, Bombay). Curr. Sci. (India); 41: No. 15, 559-60(5 Aug 1972).

Observations are reported on the current density distribution on the anode surface of a cylindrical gas discharge plasma when an rf signal is applied to a pair of ring electrodes placed at a distance of 1.3 cm from the anode on the inner and outer walls of the discharge tube. The data were used to obtain a quantitative estimate for the confinement effect. (M.O.W.)

47115 GENERALIZED NONLINEAR EXPRESSION FOR THE PLASMA DISPLACEMENT IN HARMONICA 2 AND TOKAMAK. Misguich, J. H.; Mercier, C. (EURATOM–CEA, Fontenay-aux-Roses, France). Plasma Phys.; 14: No. 4, 418-20(Apr 1972).

An expression for the displacement of plasma in a toroidal device is modified by taking into account nonlinear effects, varying plasma radius, and nonvanishing surface currents, and related to recent results obtained with the Harmonica 2 device. (UK)

Diagnostics

47116 (IPP-IV-12) SIMULTANEOUS SPECTROSCOPIC DETERMINATION OF ELECTRON DENSITY AND TEMPERATURE AS A PROOF OF RELAXATION EFFECTS IN A STREAMING ARGON–POTASSIUM–PLASMA. Dodel, G. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Jun 1971. 128p. (In German). Dep. NTIS (U. S. Sales Only).

Simultaneous measurements of electron temperature and density distributions prove that significant relaxation effects of the electron density occur in an MHD-generator-type argon–potassium plasma streaming through a channel with segmented-electrode array. Both parameters are determined spectroscopically, the electron temperature by line reversal of the potassium resonance doublet $4S_{\frac{1}{2}}-4P_{\frac{1}{2},\frac{3}{2}}$ and the electron density by absolute intensity measurement of the $4P_{\frac{3}{2}}-10D_{\frac{5}{2}}$ transition. The applicability of these two spectroscopic methods, which is by no way trivial in a transient plasma, is investigated on the basis of the quasi-steady-state theory of the relaxation process by Bates et al. The principal problem of spectroscopy in transient plasmas is substantiated in terms of this theory in a rather general way. The numerical calculations of the theory are based on an eighteen-level model of the potassium atom, the semiclassical THOMSON–GRYZINSKI collision cross sections being used. They yield population densities of the excited levels, as well as ionization and recombination coefficients as functions of the electron density and temperature. Thus, density and temperature ranges can be specified in which the spectroscopic methods mentioned above are justified. Furthermore, the specific relaxation problems occurring in the experiment can be calculated and compared to the measurements. Good qualitative agreement is found. Quantitatively, the measured electron density relaxation occurs faster than is predicted by the calculations. Finally, the numerical calculations yield the equilibrium electron density as a function of the electron temperature. Due to radiation escape, this equilibrium density appreciably deviates from the Saha density. In the experiment, however, such a significant deviation could not be verified. The discrepancy between calculated and measured equilibrium electron densities can be reduced by taking wall radiation into account. This seems to indicate that wall radiation plays a role in establishing equilibrium. (auth)

47117 SPECTRAL INTENSITY MEASUREMENTS FROM HIGH-PRESSURE NITROGEN PLASMAS. Cooper, David M. (Ames Research Center, Moffett Field, Calif.). J. Quant. Spectrosc. Radiative Transfer; 12: No. 8, 1175-89(Aug 1972).

Spectral measurements of the equilibrium radiation from nitrogen at high pressures were obtained. Experiments were performed in a ballistic range and an explosively driven shock tube. The tests covered a temperature range from 9000 to 17,200°K and a pressure range from 1.3 to 63.0 atm. Averaged electronic absorption f-numbers for $N_2^+B^2\Sigma_u^+ - x^2\Sigma_g^+$, $N_2C^3\Pi_u - B^3\Pi_g$, and $N_2B^3\Pi_g - A^3\Sigma_u^+$ bands are reported. N^- continuum radiation was not observed. (auth)

47118 REFLECTION OF MICROWAVE THROUGH LABORATORY PLASMA. Gwal, A. K.; Singh, K. P.; Shukla, P. K.; Misra, K. D. (Banaras Hindu Univ., India). Int. J. Electron.; 33: No. 1, 91-5(Jul 1972).

Propagation of microwaves through the laboratory plasma was studied. Assuming the linear electron density variation, an expression for the envelope of the reflected wave was obtained. It was observed that the propagating wave through the microwave

reflection probe is distorted when reflected back from the other end of the probe having plasma boundary. By analyzing the distorted signal thus received, the plasma parameter is estimated. (UK)

47119 TECHNIQUE FOR RECORDING LANGMUIR PROBE CHARACTERISTICS IN AFTERGLOW PLASMAS. Dean, A. G.; Smith, D.; Plumb, I. C. (Univ. of Birmingham, Eng.). J. Phys., E (London): 5: No. 8, 776-8(Aug 1972).

A technique is described for obtaining Langmuir probe current–voltage characteristics in afterglow plasmas under conditions where the ratio of the signal-to-noise levels is small. This has enabled accurate measurement to be taken of very low electron temperatures and electron densities under conditions for which it is essential to use very small probes in order to ensure that significant depletion of the plasma does not occur. The technique involves the successive accumulation of data from repetitive afterglows using multichannel scaling equipment. Sample data are presented to illustrate the value of the technique. (auth)

47120 METHOD FOR MEASURING THE DIRECTION OF THE MAGNETIC FIELD IN A TOKAMAK PLASMA BY LASER LIGHT SCATTERING. Sheffield, John (Univ. of Texas, Austin). Plasma Phys.; 14: No. 4, 385-95(Apr 1972).

It is shown that laser light passing through a magnetized plasma undergoes significant modulation when the scattering wave number is within about one degree of the magnetic field direction. By using a Fabry–Perot etalon of free spectral frequency range equal to the electron cyclotron frequency, the resulting modulation can be detected and the effect of the magnetic field determined. (UK)

47121 HIGH-SPEED PHOTOGRAPHY OF A PLASMA FOCUS. Lee, S.; Chen, Y. H.; Chow, S. P.; (and others) (Univ. of Malaya, Kuala Lumpur). Int. J. Electron.; 33: No. 1, 85-90(Jul 1972).

A coaxial plasma gun is operated with an outer glass cylinder in place of the usual copper cylinder. This enables streak and framing photographs to be readily taken of the shock-propagation region, the transition to the focus region, and the focus itself. (auth)

47122 ELECTRON TEMPERATURE DETERMINATION FROM THE RATE OF IONIZATION. Mah, S. Q.; Skarsgard, H. M.; Strilchuk, A. R. (Univ. of Saskatchewan, Saskatoon). Plasma Phys.; 14: No. 4, 422-5(Apr 1972).

The use of a technique to measure the electron temperature of a low-pressure, high-electric-field, toroidal discharge is reported. The method utilizes the observation of an increase in plasma density, and relates ionizing rate to electron energy. (UK)

47123 CALCULATION AND MEASUREMENT OF THE CHARACTERISTIC FLOW PARAMETERS OF A STATIONARY SUPERSONIC PLASMA FLOW IN A MAGNETIC DE LAVAL NOZZLE. Bitter, M.; Bartoli, C. (European Space Research Inst., Frascati, Italy). Plasma Phys.; 14: No. 6, 575-82(Jun 1972).

A Q device modified into a magnetic de Laval nozzle is used to produce a supersonic cesium plasma. It is shown that the plasma in such an experimental setup can be described by a simple adiabatic theory. The characteristic parameters of a stationary supersonic flow are calculated both for collisional and the collisionless case. The ion saturation currents measured with Langmuir probes at various positions along the magnetic nozzle are found to be in agreement with the theoretically expected thermal ion fluxes. (auth)

47124 OPTIMIZATION OF MAGNETIC PROBE MEASUREMENTS IN TRANSIENT PLASMAS. Pachner, Jaroslav Jr. Vancouver, B. C.; Univ. of British Columbia (1971). National Library of Canada, Ottawa.

Thesis.

A significant improvement in magnetic probe measurements was achieved by developing a 3-coil magnetic probe that partially corrects for the boundary error, i.e., for the error caused by an exclusion of the plasma current from the space occupied by the probe. The spatial resolution l of the three-coil probe is roughly one-half of the probe radius, a. For current distributions that vary slowly with distance (scale length, λ) it is shown that the fractional error in the magnetic field is 0.2 $(l/\lambda)^2$. For a conventional probe, the error is at least four times as large. Also, it was shown that spurious signals arising from poor probe geometry (and which often obscure the signals produced by the measured magnetic fields themselves) can be eliminated by making use of the symmetry of the discharge fields. Measurements were made on a z-pinch discharge that confirm the claimed 3-coil probe performance by revealing a "fine" structure of the current distribution in helium in the filling pressure range 0.5 to 4 torr. The measurements are presented in the form of a catalogue of the spatial distribution of magnetic field and the current density for a z-pinch discharge in He and Ar. Using the probe measurements, a qualitative model of the collapse of the current sheet for 4 torr in He is developed that differs from previous models. (Diss. Abstr. Int., B)

47125 STUDY OF OPTICAL-SCATTERING METHODS IN LABORATORY PLASMA DIAGNOSTICS. Phipps, Claude Raymond Jr. Stanford, Calif.; Stanford Univ. (1972). 127p. University Microfilms Order No. 72-20,725.

Thesis.

Electron velocity distributions are deduced along axes parallel and perpendicular to the magnetic field in a pulsed, linear Penning discharge in hydrogen by means of a laser Thomson-scattering experiment. Results obtained are numerical averages of many individual measurements made at specific spacetime points in the plasma evolution, and take advantage of the high level of reproducibility of density and velocity parameters possible in this type of discharge. Observation solid angles are made quite small to maximize resolution between the two distributions. Because of the high resolution in k space and the relatively low maximum electron density 2×10^{13} cm^{-3}, special techniques were required to obtain measurable scattering signals. These techniques are discussed and experimental results are presented. The Thomson scattering measurements show identical behavior of the longitudinal and azimuthal distributions, within experimental error. For magnetic fields below the critical value for onset of strong instability in the Penning discharge, the results show impressively good fit to a calculated Gaussian distribution, for electron energies up to 6 times the thermal energy. However, measurements above this critical field show a distinct excess of high-energy electrons which cannot be accounted for by a single Gaussian, within experimental error. Equipment-scattered light levels are the lowest ever attained in an experiment of this kind. (Diss. Abstr. Int., B)

47126 INTERPRETATION OF SIGNALS FROM A CYLINDRICAL LANGMUIR PROBE IN A STREAMING LASER-PRODUCED PLASMA. Segall, Stephen Barrett. College Park, Md.; Univ. of Maryland (1972). 235p. University Microfilms Order No. 72-20,261.

Thesis.

The applicability of the cylindrical Langmuir probe to the diagnosis of the properties of streaming, laser-produced plasmas is investigated. The regime in which probe measurements can be made is defined, and the relation of the electrostatic probe to other means of plasma diagnostics for laser-produced plasmas is explained. A theory to explain the current characteristic for a probe in a laser-produced plasma is developed. First, the theory for a probe in a stationary plasma is analyzed to develop a stationary analog to the flowing-plasma case. In the process, it is found that the general theory for a cylindrical probe in a stationary plasma, as developed by Bernstein and Rabinowitz and Laframboise, can be considerably simplified both theoretically and computationally. This simplified general theory is then used to reexamine several fundamental concepts of probe theory and the behavior of the probe for various changes of plasmas and probe parameters. Relations applicable to the case of a probe in a high-velocity flowing plasma are developed and used to modify the Langmuir theory for a probe in a collisionless flowing plasma. Experimental procedures for the use of cylindrical Langmuir probes to diagnose streaming, laser-produced plasmas are described, and experimental current–voltage characteristic curves are analyzed using the theory for a probe in a flowing plasma which has been developed. Density and temperature values are obtained for copper and aluminum plasmas at various times during the flow. Reasons for deviations from theoretical behavior are discussed. (Diss. Abstr. Int., B)

47127 TIME-RESOLVED DIAGNOSTIC METHOD FOR HYDROGEN PLASMAS. Edwards, David F. (Colorado State Univ., Ft. Collins); Bacon, M. E.; Litvak, M. M. Int. J. Electron.; 33: No. 1, 105-12(Jul 1972).

A time-resolved plasma diagnostic method is described as it applies to laser-produced sparks in hydrogen gas. Electron densities and temperatures in the ranges of 10^{19} to 10^{17} cm^{-3} and 10^6 to 10^4°K, respectively, can be determined with nanosecond time resolution. The diagnostic method is not necessarily restricted to hydrogen plasma and suggestions are given as to possible extensions to other types of plasma. (auth)

47128 PLASMA-SAMPLING DIAGNOSTICS USING ION KINETIC ENERGY DISTRIBUTIONS. Seguin, J. G.; Dugan, C. H.; Goodings, J. M. (York Univ., Toronto). J. Mass Spectrom. Ion Phys.; 9: No. 2, 203-13(Jul 1972).

Kinetic energy distributions of ions extracted from a microwave discharge in nitrogen are used to diagnose the influence of the

plasma sheath on the sampling process. Nitrogen plasmas having $n_e \simeq 10^9$ to 10^{10} cm^{-3} and $kT_e \simeq 1$ eV were examined over the pressure range 0.02$_2$ to 0.42 torr. Over this range N_4^+ and N^+ are the major ion species with N_4^+ predominant by approximately one order of magnitude. The ions are sampled from the bulk phase through the plasma sheath which forms over a tiny platinum leak. The leak itself acts as a circular planar Langmuir probe. After passage through the leak, the ions are analyzed for kinetic energy by a series of planar retarding grids and then mass-analyzed using a quadrupole mass spectrometer. Analysis of the ion kinetic energy distributions indicates that a model of the plasma sheath dominated by mobility considerations is applicable for pressures >0.42 torr. On the other hand, a collisionless free fall sheath model is applicable at pressures <0.02$_2$ torr. However, the sampling is complicated by the occurrence of ion–molecule reactions in the sheath. The evidence suggests that the cross section for dissociative charge transfer $N_4^+ + N_2 = N^+ + N + N_2$ exceeds that for symmetric charge transfer $N_4^+ + N_2 = N_2 + N_4^+$ at low pressure; the reaction $N_4^+ + N_2 = N^+ + N_3$, if present at all, does not play a major role. (auth)

47129 SPECTROGRAPHIC MEASUREMENT OF THE TEMPERATURE OF A PLASMA ANALYZED BY STATISTICAL METHODS. Murino, Pasquale (Univ., Naples). Aerotec.-Missili Spazio; 50: No. 6, 352-9(Dec 1971). (In Italian).

The local temperature of an ionized gas can be indirectly determined by measuring the emitted radiation intensity per unit volume. For an axisymmetric and optically thin plasma the lateral intensity I (x) of the emitted radiations can be easily measured through spectroscopic methods; therefore, it is necessary to solve Abel's integral equation to get the radiation intensity per unit volume. The numerical evaluation of Abel's integral was obtained through a method based on the approximation of I (x) with a sum of polynomials orthogonal with respect to a suitable weight function. The method seems to be interesting as it is not very sensitive to the random errors of the measurements while it shows a fairly good numerical accuracy. Spectrographic measurements were made of the radiations emitted by a laboratory plasma in several experimental conditions. Abel's inversion was done by using this method and the results obtained were satisfactory. (auth)

Kinetics (General)

Refer also to abstracts: 46361 and 46425.

47130 PLASMA CURRENT CONDUCTION TO A COLD ELECTRODE. Kern, Robert Allyn. Cleveland; Case Western Reserve Univ. (1972). 180p. University Microfilms Order No. 72-18,698.

Thesis.

The sheath region adjacent to a cold electrode in a partially ionized gas is investigated in detail for the case of the Debye length smaller than an ion–atom mean free path. From the physics of ion–atom collisions, two limiting collision models are developed for the case of argon. Utilizing these models, a procedure is developed for joining the kinetic theory and continuum descriptions at the point where the two expressions give the same value for the electron-temperature gradient. This matching procedure effectively utilizes a generalized Bohm criterion as a boundary condition. This matching procedure is compared with sheath models for local variations in physical quantities and for the effects on the solution for an ionization dominated flowing plasma under shock tube conditions. This latter comparison is chosen because it provides a good test of the sheath models, it is typical of MHD applications, and the results can be compared to shock-tube experiments. It is shown that the various sheath models differ considerably in their description of the region adjacent to the electrode. Nevertheless, in some cases the ion current drawn to the electrode is insensitive to these discrepancies because there is little ionization near the electrode. By comparison with experiments and estimates of convection it is determined that for the lower range of shock tube pressures for argon, convection is the dominant current-producing mechanism. At the higher range of shock tube pressures, ionization is probably dominant. Although the matching procedure is not strictly valid at the higher shock tube pressures, there are ionization-dominated applications where the matching procedure would be valid. (TSS) (Diss. Abstr. Int., B)

47131 OBSERVATOIONS OF PRECURSOR IONIZATION IN ELECTROMAGNETIC T TUBES. McRae, Thomas G. Gainesville, Fla.; Univ. of Florida (1971). 65p. University Microfilms Order No. 72-16,631.

Thesis.

An experiment was designed which measures the photoionization of a room-temperature gas by the radiation emitted from a hot plasma. The radiation source is a Mach 5 shock wave in xenon which is separated from an absorption chamber by a lithium-fluoride window. The shock was produced by a curved electromagnetic T-tube. The emission just prior to shock-wave reflection was collimated and projected through the absorption chamber to an electrostatic double probe 232 cm away. Electron number densities were recorded in Xe, Ar, Kr, and residual gas at various absorption chamber pressures. A qualitative test of the photoelectric effect on the system boundaries was conducted and both axial and transverse shock tube spectra were recorded. The results of this experiment show that, in electromagnetically driven shock tubes, precursor ionization is the result primarily of radiation, not of ionizing potential waves as recently hypothesized. Furthermore, this ionization is produced by wavelengths greater than 1200 Å but less than 3000 Å and it is predominantly the impurities in the system which become ionized. The photoelectric effect on the system walls was present but found to be negligible at normal shock-tube pressures. (Diss. Abstr. Int., B)

47132 PRELIMINARY RESULTS OBTAINED FROM THE STUDY OF AN ARGON PLASMA CONTINUUM IN THE NEAR ULTRAVIOLET AND VISIBLE RANGES AT HIGH PRESSURES. Goldbach, Claudine; Nollez, Gerard (Centre National de la Recherche Scientifique, Paris). Compt. Rend., Ser. B; 274: No. 16, 970-3(17 Apr 1972). (In French).

The continuum produced by thermal plasmas in the 10^4K temperature region is essentially due to recombination, and may be theoretically described using the Biberman–Schluter $\xi(\lambda,T)$ function. The values of $\xi(\lambda,T)$ calculated by Schluter explain most of the experimental results; very little work has been done in comparing theory and experiment for pressures higher than atmospheric pressure. Measurement of the K_λ absorption coefficient of the plasma, produced in a variable-length stabilized arc, allowed the $\xi(\lambda,T)$ function to be determined in the $1 \leq p(atm) \leq 30$ pressure range. (France)

47133 ELECTRON ENERGY DISTRIBUTION AND STRIATIONS IN THE LANGMUIR-PARADOX REGION. Kondrat'ev, A. A.; Milenin, V. M.; Tsendin, L. D. (Leningrad State Univ.). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 1, 71-5(Jul 1972).

Translated from Zh. Tekh. Fiz.; 42: No. 1, 94-9(Jan 1972).

A quantitative study is made of striations in a helium discharge under the conditions of the Langmuir paradox. The effective frequency of randomizing collisions is calculated; the pressure dependence of this frequency is consistent with a wall mechanism for electron randomization. The hydrodynamic approximation is used to analyze striations at low pressures; the theoretical and experimental results show agreement. (auth)

47134 NOTE ON PLASMA ACCELERATION CAUSED BY PLASMA TURBULENCE. Motz, H. (Oxford Univ.); Tsytovich, V. N. Plasma Phys.; 14: No. 6, 583-9(Jun 1972).

Momentum exchange between two plasmas in relative motion, one more dense than the other, is investigated. It is concluded that the dominant turbulent process is the scattering of Langmuir waves by ions of the denser plasma. The length over which the relative motion ceases increases with the fourth power of the ratio of the relative speed to the thermal velocity. When the relative velocity exceeds a critical value, the generation of Langmuir turbulence is stabilized and eventually the order motion is no longer dispersed. Application to a laboratory experiment is discussed and it is also suggested that the process investigated might be of importance in the case of galaxies expanding into intergalactic gas. (auth)

47135 IMPEDANCE OF A PARTIALLY IONIZED CESIUM PLASMA. Yamada, Jun; Okuda, Takayoshi (Nagoya Univ., Japan). Jap. J. Appl. Phys.; 11: No. 7, 1032-8(Jul 1972).

The impedance of a partially ionized cesium plasma is measured over a wide range of signal frequency. A theory is developed, taking into account the perturbations of the density, velocity, and temperature of the electron and also of the population of the excited states of the atom for the response of such a plasma to an ac electric field of small amplitude. The impedance formula derived from the above is confirmed by the experiment. (auth)

47136 CATHODE HEATING IN AN ASYMMETRICALLY BURNING PENNING DISCHARGE. Hopfgarten, N. (Royal Inst. of Tech., Stockholm). Plasma Phys.; 14: No. 4, 397-401 (Apr 1972).

Ions and electrons bombarding the cathodes in a Penning discharge in a magnetic mirror field heat the cathodes and release secondary electrons. From measurements of cathode heating, currents, and burning voltages, it is possible to estimate the density and energy of ions leaving the discharge to the cathodes, as

well as the currents of electrons arriving at the cathodes and the currents of electrons leaving them. (UK)

47137 MASS, MOMENTUM, AND ENERGY FLOW FROM AN MPD ACCELERATOR. Cory, John Slane. Princeton, N. J.; Princeton Univ. (1971). 112p. University Microfilms Order No. 72-18,799.

Thesis.

The mass, momentum, and energy flows through a quasi-steady, self-field MPD accelerator are measured over a current range of 8 to 50 kA and inlet mass flows of 2 to 36 g/s of argon. Time-resolved arc chamber pressure and impact pressure in the exhaust jet, measured with a piezoelectric pressure probe capable of operation with a flat response from 1 to 140 kc, are used to calculate the momentum flux profiles, the gasdynamic contribution to thrust, and the total thrust. The momentum flux profile indicates that the accelerator produces a uniform, 2-inch-diameter axial jet at the anode which expands into a Gaussian profile at an axial station 11 inches from the anode. The electromagnetic component of the thrust is found to follow the familiar quadratic dependence on arc current, while a more complex empirical relation is needed to correlate the gasdynamic contribution with the current and mass flow rate. Using available time-of-flight velocity profiles at a current of 16 kA and a mass flow of 5.9 g/s, calculated flux profiles of mass and kinetic energy exhibit a tendency for some fraction of the inlet mass flow to leak out at a low velocity around the central high-velocity core. Discharge chamber geometry changes to eliminate the leakage will doubtless improve the arc performance. (Diss. Abstr. Int., B)

47138 PROCESSES AND MEASUREMENTS IN AN ABNORMAL NEGATIVE GLOW PLASMA. Kaul, Ashok Kumar. College Park, Md.; Univ. of Maryland (1972). 174p. University Microfilms Order No. 72-20,251.

Thesis.

A stable dc discharge system using a brush cathode, and capable of generating a negative glow of useful dimensions, is described. Measurements of electron densities and temperatures were made under steady-state conditions along the axis of the glow, using a 1-mil cylindrical Langmuir probe. A preliminary investigation of the "hysteresis" encountered in the Langmuir-probe characteristics showed that this effect is probably caused by the variation in surface contact potential arising from the neutralization of certain types of impurity ions and their subsequent adsorption by the probe surface. Electron and ion densities are found to satisfy quasi neutrality for the negative glow plasma, and range from about 2.4×10^9 to 3×10^{12} cm^{-3}, with the electron temperature first decreasing with increasing pressure from about 1500 to 650°K, and then increasing again to about 2000°K at a pressure of approximately 1 torr. The plasma is found to be fairly homogeneous axially, and the effect of the discharge current was also investigated. A theoretical model is presented to explain the observed densities and temperatures, and in particular, the behavior of the electron temperature. This model assumes the existence of the metastable–metastable ionizing collisions and the superelastic collisions in addition to the impact ionization heating mechanism. The loss or cooling mechanisms assumed are ambipolar diffusion, recombination, and elastic collisions with ions and neutral gas atoms, while the effect of electron–electron collisions is also included. This yields reasonable agreement with measured electron temperatures and gives the correct temperature variation. The observed electron densities are well explained on the basis of a recombination-dominated plasma over most of the range of the experiment. The recombination-rate coefficients obtained are in the vicinity of the collisional-radiative rates of Kingston, Bates, and McWhirter. (Diss. Abstr. Int., B)

47139 OBSERVATION OF SECOND COMPRESSION IN THE FINAL STAGE OF A DISCHARGE OF THE PLASMA FOCUS TYPE. Gribkov, V. A.; Korzhavin, V. M.; Krokhin, O. N.; (and others) (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 15: No. 6, 232-4(20 Mar 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 6, 329-32(20 Mar 1972).

Results are presented of a high-speed interferometry study of the final plasma focus (PF) stage. The results show that the PF current sheath becomes ruptured at the instant of maximum of the hard x-ray pulse, that the remaining parts of the sheath are additionally compressed, and turbulence develops at the rupture place. The results also establish an additional mechanism whereby the plasma flows out of the sheath. (M.O.W.)

47140 MODEL FOR THE HOLLOW CATHODE DISCHARGE. Lorente-Arcas, A. (Paris Univ., Orsay, France). Plasma Phys.; 14: No. 6, 651-9(Jun 1972).

The existence of a local overpressure in a hollow-cathode discharge (HCD) has been detected. In order to explain this, it is supposed that the plasma density in the active zone is essentially determined by the equilibrium between the ionization produced by the electron current and the electron–ion recombination. In the same way, the total density of atoms plus ions in the active zone is determined by the gas flow. The up-stream limit of the active zone is found to be a thin sheath created by ambipolar diffusion and recombination between electrons and ions (ADAR sheath); one criterion for such a sheath to exist has been found. The variation of pressure up-stream from the active zone in terms of the discharge current has been found. By comparing the theory with experiment, a total recombination coefficient is found whose order of magnitude is in agreement with the values given in the literature. (auth)

Kinetics (Experimental)

47141 (LA-DC-72-703) PLASMA EXPERIMENTS IN THE SCYLLAC 5-METER, LINEAR θ PINCH. Thomas, K. S.; Harris, H. W.; Jahoda, F. C.; Sawyer, G. A.; Siemon, R. E. (Los Alamos Scientific Lab., N. Mex.). 1971. 4p. (CONF-720710-5). Dep. NTIS.

From second topical conference on pulsed high-beta plasmas; Garching, Germany (3 Jul 1972).

Experiments are reported on the behavior of the plasma column in a straight high-voltage θ pinch which may be operated both with and without strong magnetic mirrors. Operation without mirror fields produced a high temperature (2 to 3 keV) plasma column which lasted about 15 μsec, showed considerable "wobble," and also showed effects due to plasma contamination of the discharge tube by material "boiled" off the quartz discharge tube by the previous discharge. Enlarging the discharge tube outside the coils reduced this problem. In the data so far, when mirror fields which give a mirror ratio of 2 to 3 are applied at the same time as the main field, the plasma column shows evidence of a m = 1 instability. (auth)

47142 NEUTRAL-POINT DISCHARGE EXPERIMENT. Ohyabu, Nobuyoshi; Kawashima, Nobuki (Tokyo Univ.). J. Phys. Soc. Jap.; 33: No. 2, 496-501(Aug 1972).

The behavior of a plasma current through a magnetic neutral point is investigated experimentally. A quasi-steady magnetic field (either cusp or quadrupole magnetic field) is created by a slow capacitor discharge, and the plasma sheet current is excited by a slow capacitor discharge. The plasma current sheet thus formed is collapsed into small filamentary pinches, and they are ejected outward on the current sheet plane along the magnetic field lines. This seems to correspond to the ejection of plasma and energetic particles associated with solar flares. The visual observation together with double probe and Rogowski coil measurements show that the collapse of the plasma current occurs earlier as the plasma current and the external magnetic field are increased and as the initial gas pressure is decreased, and this is explained qualitatively by the resistive tearing-mode instability. (auth)

47143 ENHANCED FAR-INFRARED RADIATION FROM A THETA-PINCH PLASMA. Chin-Fatt, Cecil A. College Park, Md.; Univ. of Maryland (1972). 95p. University Microfilms Order No. 72-20,785.

Thesis.

A nonthermal spectrum was observed of far infrared radiation, covering a wavelength range of approximately 0.4 mm to 2 mm emitted by the turbulent helium plasma of a theta pinch with a strongly diffusive magnetic piston, at a peak intensity that is at least three orders of magnitude greater than that expected of an equivalent thermal plasma. Line emission and magnetic probe studies in addition to the temporal development and the observed two-banded structure of the enhanced nonthermal spectrum, support the interpretation of this far infrared emission to be direct evidence of two nonlinear radiation phenomena, involving the interactions of longitudinal electron waves with plasma inhomogeneities and with themselves and resulting in bremsstrahlung radiation at the plasma frequency, ω_{pe}, and its harmonic $2\omega_{pe}$; these radiation processes were theoretically proposed to explain types II and III radio bursts associated with solar flares. A theoretical estimate, based on a fluid plasma model, gave fair agreement with the observed intensity of the far infrared radiation. (Diss. Abstr. Int., B)

47144 SYNCHROTRON RADIATION FROM A MAGNETICALLY CONFINED HOT-ELECTRON PLASMA. Nee, Soe-mie Foeng. College Park, Md.; Univ. of Maryland (1972). 189p. University Microfilms Order No. 72-20,260.

Thesis.

The spectrum of the synchrotron radiation emitted by the elec-

tron cloud produced in the University of Maryland pulsed magnetic-mirror compression experiment was measured in a wavelength region from 3.0 cm to 0.3 mm using three independent detector systems. The measured spectra agree with the theoretical spectra calculated using a distribution function derived from a relativistic Maxwellian distribution function that conserves the magnetic moments of the trapped electrons during magnetic compression of the electron cloud. This agreement demonstrates that the electron cloud is compressed adiabatically and that electrons are not lost during the decay of magnetic field. The analytical expressions of this distribution function and its generalization to the three-dimensional case are derived. Single-particle effects on the measured spectrum of synchrotron radiation are also investigated. The effects of a finite aperture is to broaden the cyclotron lines and to change the intensity by $(1 - \beta_{||} \cos \theta)$ such that the observed synchrotron radiation, including the aperture effect and the retardation effect, is just equal to the radiation emitted by an electron drifting freely along the magnetic field. The correction for the electron passing through the observing window is to split the broadened spectrum due to the finite aperture into many lines separated by the longitudinal frequency. The spectrum of the synchrotron radiation for an electron confined in a static inhomogeneous magnetic mirror field covers a wide continuous frequency range approximately from $\omega_c/(1 + \beta_{||} \cos \theta_0)$ to $\omega_c/(1 - \beta_{||} \cos \theta_0)$, and its shape depends entirely on the field configuration. This correction is important for observation along the magnetic axis and is negligible for observation perpendicular to the magnetic axis. (Diss. Abstr. Int., B)

Kinetics (Theoretical)

Refer also to abstracts: 47163, 47164, and 47182.

47145 (COO-3086-15) RESEARCH IN COMPUTATIONAL PLASMA PHYSICS. Progress Report, March 1, 1971–March 1, 1972. Chu, C. K.; Taussig, R. T. (Columbia Univ., New York). 1 Mar 1972. Contract AT(11-1)-3086. 10p. Dep. NTIS.

Research progress on the following four areas is briefly described: (1) numerical simulation of the shock tube; two-dimensional one-fluid MHD code, (2) heat transfer studies for the shock tube, (3) Vlasov equation and ion acoustic phenomena, and (4) simulation of slightly collisional plasmas. (M.O.W.)

47146 KINETIC THEORY OF A TWO-DIMENSIONAL MAGNETIZED PLASMA. Vahala, George Martin. Iowa City, Iowa; Univ. of Iowa (1972). 199p. University Microfilms Order No. 72-17,613.

Thesis.

Several features of the equilibrium and nonequilibrium statistical mechanics of a two-dimensional plasma in a uniform dc magnetic field are investigated. The calculations have been motivated by the recent derivation of Bohm's diffusion coefficient given by Taylor and McNamara for this system. The charges interact only through electrostatic (logarithmic) potentials. The problem is considered both with and without the guiding-center approximation. With the guiding-center approximation, an appropriate Liouville equation and BBGKY hierarchy predict no approach to thermal equilibrium for the spatially uniform case. For the spatially nonuniform situation, a guiding-center "Vlasov" equation is discussed and is solved in special cases. The guiding-center model is shown to be equivalent to the fluid mechanics problem of the motion of rectilinear vortices in an inviscid, incompressible fluid. The most interesting features of thermal equilibrium theory (with and without the guiding-center approximation) are (1) a collapse of the system above a critical value of the plasma parameter (May 1967); and (2) a divergence in the electric field fluctuation spectrum (minus the self-energy terms) for small plasma parameter and very large systems. For the nonequilibrium, nonguiding-center case, a Boltzmann equation and a Fokker–Planck equation are derived in the appropriate limits. The Fokker–Planck equation is more tractable than the Boltzmann equation, but contains a divergent integral which must be cut off on physical grounds. This cutoff is compared to the standard cutoff introduced in the two-dimensional unmagnetized Fokker–Planck equation. In the low plasma parameter it is shown, under the assumption that for large (integer) n $(\gamma_n/\gamma_{n+1}) = O(n^p)$, $p < 2$ where $\gamma_n \cong \omega_n - n\Omega$, with ω_n the n^{th} Bernstein mode and Ω the electron gyrofrequency, that the Balescu–Lenard collison term is zero in the long-time average limit if one considers only two-body interactions. The energy transfer from a test particle to an equilibrium plasma is discussed and also shown to be zero in the long-time-average limit. This supports the result of zero Balescu–Lenard collision term. (Diss. Abstr. Int., B)

47147 NUMERICAL SIMULATION OF RELATIVISTIC ELECTRONS CONFINED IN AN AXISYMMETRIC MIRROR FIELD. Brettschneider, Marcel. Davis, Calif.; Univ. of California (1971). 145p. University Microfilms Order No. 72-17,898.

Thesis.

In the controlled fusion experiment, Astron, a beam of relativistic electrons is injected into a partially evacuated cylindrical region in which an externally applied magnetic field has been established. The cylindrical region is bounded by two concentric aluminum shells. The applied field, in most cases, is solenoidal. It is generated by a large number of coils located outside of and concentric with the cylindrical region. Generally, the currents in the coils are programmed to create a shallow magnetic mirror near one end of the region and a steep mirror field at the other end. The electrons are injected near that end of the region which contains the shallow mirror. Their subsequent trajectories are helical. To make it easier to trap the electrons, a cylinder of azimuthally oriented resistor wires, concentric with and located somewhat inside of the outer cylinder, was installed. The electrons trapped form a cylindrical shell known as the E-layer. If enough electrons are trapped, the self-field of the E-layer can exceed the applied field, resulting in a magnetic field configuration which includes a region which is minimum |B| and has no loss cones. A mathematical model that is capable of simulating the formation of the E-layer was developed and is described here. The model assumes axial symmetry. It includes all the physics described above, and also the effects of the neutralization of the electric field of the injected electrons due to their interaction with the background gas. This model was used to study the formation of an E-layer when one pulse of electrons was injected. It was also used to study the effect of injecting a number of pulses in succession. The results are in good qualitative agreement with the observed experimental results. (TSS) (Diss. Abstr. Int., B)

47148 EFFECTS OF ION MOTION ON SPECTRAL LINE BROADENING IN PLASMAS. Roszman, Larry Joe. Gainesville, Fla.; Univ. of Florida (1971). 219p. University Microfilms Order No. 72-16,652.

Thesis.

The effect of ion motion on the broadening of atomic spectral lines by plasmas is examined. A review and discussion of the quasi-static ion theory of plasma line broadening and previous work on the problem of ion motion are included. It is concluded that two important aspects of the ion perturbations of the radiator must be taken into account when examining ion motion. First, many ions interact simultaneously with the radiator, i.e., multiple collisions between the ions and the radiator are overwhelmingly significant. Second, neither the quasi-static nor the time-dependent ion–radiator interaction can be well treated by finite-order time-dependent perturbation theory. Forms of the time-dependent ion microfield distribution suitable for numerical computation are derived first for an ion gas neglecting ion–ion correlations, and then for an ion gas including ion–ion correlations. The derivations of the expressions for the second case are based upon time-dependent generalizations of the cluster-expansion and collective-coordinate methods employed by Hooper for the quasi-static microfield distribution. Some numerical results are given for the case which neglects ion–ion correlations. It is found that the effects of ion motion are significant for frequency separations from the line center less than the reciprocal of the time it takes an ion traveling with the average thermal velocity to cross the ion sphere radius. (TSS) (Diss. Abstr. Int., B)

47149 TOTAL ENERGY LOSS OF A TEST CHARGE IN A COLLISIONAL MAGNETOPLASMA. Shukla, P. K. (Umeaa Univ., Sweden); Singh, R. N. Phys. Scr.; 4: No. 6, 281-9(1971).

A general theory of energy attenuation of a charged test particle in a cold, collisional plasma is developed. The effect of collisions on the plasma properties is investigated. The radiation characteristics of a spiralling test particle are discussed. In the presence of collisions it is found that absorption is important when the collision frequency is comparable to the wave frequency. Estimates of radiated and absorbed power by test charges of different energies are made, and the role of collisions on the power spectrum is studied in detail. (auth) (Sweden)

47150 SELF-CONSISTENT PAIR CORRELATIONS AND DIELECTRIC RESPONSE IN A PLASMA. Abramo, M. C.; Tosi, M. P. (Univ., Messina, Italy. CNR, Messina, Italy). Nuovo Cim.; 10B: No. 1, 21-35(11 Jul 1972).

The self-consistent approach to the determination of the dielectric response function and of pair correlations in an electron liquid, developed by Singwi et al., is systematically examined in the classical limit. The self-consistent equation for the pair correlation function is obtained from the second equation of the BBGKY hierarchy, by a decoupling approximation on the triplet

correlation function which takes account of the limiting behaviors at long wavelengths and at short distances. In the same order of approximation an effective two-body potential is derived by an alternative decoupling scheme, whose use allows one to improve the self-consistent pair correlation at short distances. A collective potential, inclusive of local field corrections, is also proposed for the evaluation of the wave vector and frequency-dependent dielectric function in both the classical and the degenerate electron liquid. The decoupling approximation is shown to be consistent with the second-order perturbative treatments of the triplet function which separately apply in the long-wavelength domain and in the short-distance domain, and the systematic extension of the decoupling scheme to higher orders is indicated and illustrated. The present results are expected to be of practical usefulness in the treatment of correlations in the degenerate electron gas at metallic densities and in the high-density, low-temperature plasma. (auth)

47151 NON-LINEAR THEORY OF INSTABILITY OF A MONO-ENERGETIC ELECTRON BEAM IN PLASMA. Matsiborko, N. G.; Onishchenko, I. N.; Shapiro, V. D.; Shevchenko, V. I. (Physical Technical Inst., Kharkov). Plasma Phys.; 14: No. 6, 591-600(Jun 1972).

The excitation of a monochromatic plasma wave by a "cold" electron beam is investigated. The solution obtained describes the transition from the exponential growth of the wave amplitude in the linear stage to the amplitude osicllations associated with trapping of the beam in the potential well created by the wave. The maximum amplitude and its oscillation period are found. Both nonrelativistic and relativistic beams are investigated. (auth)

47152 BREMSSTRAHLUNG PHOTON EMISSION RATE FROM MAXWELLIAN PLASMAS. Halverson, W. (Massachusetts Inst. of Tech., Cambridge). Plasma Phys.; 14: No. 6, 601-4(Jun 1972).

The bremsstrahlung photon emission rate from a Maxwellian plasma for photon energies greater than a given threshold value is expressed in terms of a rapidly converging series. The results are used to determine the applicability of soft x-ray diagnostic techniques for laser-produced plasmas, as a function of electron temperature and detector threshold energy. (auth)

Production

47153 (NP-19364) PRODUCTION AND MEASUREMENT OF INTENSE ION BEAMS AND BEAM-PRODUCED PLASMA IN A CUSPED MAGNETIC FIELD. Huizenga, W. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Mar 1972. 86p. Dep. NTIS (U. S. Sales Only).

Experimental work on the production and current measurement of intense hydrogen-ion beams in pulsed condition (60 mA at 20 kV) is described. In order to produce an intense ion beam, use is made of a duoplasmatron provided with a plasma-expansion cup at anode potential. Results obtained with various configurations of grids mounted in the ion-extraction region were compared. The use of concave grids appears to be a good expedient for the production of ion beams with sufficient initial focusing to balance space-charge repulsion. Beam-current measurements were made with a Faraday collector provided with a secondary-electron suppressor. Observations show that the voltage needed to suppress the escape of secondary electrons from the collector is approximately proportional to the space-charge potential of the beam in the center of the collector entrance. Special attention was paid to the beam composition, as was proved necessary in these experiments. Next, the formation of plasma by injection of a 20-keV hydrogen-ion beam into a quadrupole magnetic-containment device was studied. Electron-density measurements were made with a 9-mm microwave interferometer and with resonance-shift methods using the metallic vessel as a cavity. Also, current measurements were made with collectors located in the mirror regions. The plasma density in the steady state appears to be proportional to the gas pressure in the range up to 10^{-4} torr. Under normal conditions (injected current 50 mA, gas pressure 2×10^{-5} torr), the average density is about 5×10^{8} el cm^{-3}. The observed plasma-ion temperature is about 150 eV at low gas pressure, whereas the electron temperature does not exceed a few eV. The energy transfer from the hot-ion component to the plasma is in the order of one part per thousand. The energy transfer is thought to be caused by collective effects (beam–plasma interaction). Considerations on the plasma–particle balance lead to the existence of a positive plasma potential in the center during the steady state (about 70 V at low gas pressure). The existence of this potential was confirmed experimentally. (auth)

47154 FORMATION OF THE ENERGY SPECTRUM OF THE IONS OF A LASER PLASMA. Bykovskii, Yu. A.; Vasil'ev, N. N.; Degtyarenko, N. N.; (and others) (Moscow Engineering Physics Inst.). JETP Lett. (USSR) (Engl. Transl.); 15: No. 6, 217-20 (20 Mar 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 6, 308-11(20 Mar 1972).

The effects of acceleration and recombination on the ion energy spectra were investigated. A detailed study was made of the energy distributions of hydrogen and zirconium ions and deuterium and lithium ions (LiD) at different flux densities. Energy distribution diagrams are given. (M.O.W.)

47155 MOMENTUM TRANSFER AND PLASMA FORMATION ABOVE A SURFACE WITH A HIGH-POWER CO_2 LASER. Pirri, A. N.; Schlier, R.; Northam, D. (Avco Everett Research Lab., Everett, Mass.). Appl. Phys. Lett.; 21: No. 3, 79-81(1 Aug 1972).

An experiment was performed to measure the total impulse transferred to a surface by a high-power pulsed 10.6-μ laser under atmospheric conditions, and also to determine the degree to which the observed plasma decouples the laser energy from the surface. Specific interest was directed toward conditions under which a "radiation-driven detonation wave" may form due to the presence of a surface. The momentum transferred in dyn sec/J decreases with an increase in the ratio of incident energy to spot area since a larger fraction of the energy is decoupled from the surface. (auth)

Stability

47156 (LA-DC-72-706) PLASMA EXPERIMENTS ON l = 1,0 HELICAL EQUILIBRIA IN THE SCYLLAC 5-METER θ-PINCH TOROIDAL SECTOR. Ellis, W. R.; Hammer, C. F.; Jahoda, F. C.; Quinn, W. E.; Ribe, F. L.; Siemon, R. E. (Los Alamos Scientific Lab., N. Mex.). 1972. 4p. (CONF-720710-3). Dep. NTIS.

From second topical conference on pulsed high-beta plasmas; Garching, Germany (3 Jul 1972).

Experiments are reported on a sector comprising one third of the 4.8-m-diameter Scyllac torus. The toroidal force and outward plasma drift are compensated by an interference force produced by a combination of l = 1 helical fields and l = 0 bumpy fields. The toroidal equilibrium is observed, followed by an m = 1 (sideward) motion of the plasma column, which is nearly the same all along the torus, independent of the l = 0 periodicity, with plasma containment times as large as 11 μsec, comparable to times for plasma end loss. The m = 1 motions, which occur predominantly in the horizontal plane of the torus, suggest either an imbalance between the l = 1,0 and toroidal forces at later times or a long wavelength m = 1 instability. Measurements of the applied magnetic fields show that the product of l = 1 and l = 0 fields for plasma equilibrium agrees with sharp-boundary MHD theory. Time-resolved measurements of the plasma diamagnetism, electron density distribution, neutron emission, and beta are reported. (auth)

47157 (LA-DC-72-707) FEEDBACK STABILIZATION ON AN l = 1 THETA-PINCH PLASMA COLUMN. Gribble, R. F.; Burnett, S. C.; Harder, C. R. (Los Alamos Scientific Lab., N. Mex.). 1971. 4p. (CONF-720710-4). Dep. NTIS.

From second topical conference on pulsed high-beta plasmas; Garching, Germany (3 Jul 1972).

An l = 0 MHD feedback experiment to control the m = 1 instability on a plasma column subject to l = 1 helical fields is described. The feedback system has three basic components: a position detector, a signal processor, and a power amplifier. Feedback stabilization is being tried first on a linear θ pinch (Scylla IV-3). Horizontal and vertical motions of the plasma column are optically sensed with fast-rise-time silicon bi-cell detectors. The signal processor provides amplitude and derivative control and normalization of the detector signals. Ten power-amplifier modules in push–pull configurations are used to drive the l = 0 windings. The l = 1 coils which drive the instability are driven by a crowbarred capacitor bank. The module output power of 30 MW rises in 1.3 μsec and may be sustained for as much as 20 μsec. From detector output to power-module output the power gain of the feedback system is 7×10^{14}. (auth)

47158 (LA-DC-72-726) RECENT RESULTS FROM THE SHOCK-HEATED TOROIDAL Z-PINCH EXPERIMENT ZT-1. Burkhardt, L. C.; Di Marco, J. N.; Forman, P. R.; Haberstich, A.; Karr, H. J.; Phillips, J. A. (Los Alamos Scientific Lab., N. Mex.). 1971. 4p. (CONF-720710-1). Dep. NTIS.

From second topical conference on pulsed high-beta plasmas; Garching, Germany (3 Jul 1972).

Preionization in this experiment is produced by a ≲20 kA z-current of period ~30 μsec. The degree of ionization and radial distribution of current density are functions of the filling pressure and strength of the preionization current. After the start of the main z current, with initial $\dot{B}_\theta$ (wall) of ~60 kG/μsec and peak currents of ~200 kA, plasma pressure profiles show a positive pressure gradient on axis, as required for MHD stability, existing for times of at least 8 μsec (current zero at ~11 μsec). The plasma β_θ is ~0.4 at 5-mtorr filling pressure and increases with the filling pressure. Plasma temperatures ($T_i + T_e$) of 1 to 4 keV are inferred from the pressure profiles and initial gas-filling densities with the higher temperatures corresponding to the lower pressures (2 mtorr). When the B_z field outside the pinch column is reversed, streak photography and MHD stability analysis show significant improvement towards stability. High plasma conductivity prevents the zero in B_z from moving away from the wall more than ~0.5 cm. (auth)

47159 (UCRL-Trans-10630) STABILITY OF A FINITE-PRESSURE PLASMA WITH AN ANISOTROPIC ELECTRON-VELOCITY DISTRIBUTION. Egorenkov, V. D.; Stepanov, K. N. Translated for Univ. of California Lawrence Livermore Lab., Livermore, from Ukr. Fiz. Zh. (Russ. Ed.); 15: No. 2, 325-30 (1970). 12p. Dep. NTIS.

A homogeneous finite-pressure plasma with hot electrons and cold ions and with an anisotropic electron distribution is considered. It is shown that, in the high-frequency range $\omega_{He} \gg |\omega| \gg \omega_{Hi}$, the instability region for electromagnetic waves analogous to whistlers and ion-acoustic waves coincides with that for diamagnetic and firehose instabilities. Since the growth rates of the unstable oscillations considered are appreciably greater than the ion cyclotron frequency, these instabilities are more dangerous than the diamagnetic and firehose ones, for which the growth rates are considerably smaller than ω_{Hi}. (auth)

47160 CONVECTION OF A PLASMA IN A GRAVITATIONAL FIELD. Wobig, Horst (Princeton Univ., N. J.). Plasma Phys.; 14: No. 4, 403-16(Apr 1972).

It is shown that the interchange instability of a magnetoplasma in a gravitational field can be stabilized by the combined effects of viscosity and resistivity. (UK)

47161 ABSOLUTE AND CONVECTIVE INSTABILITIES. Bijlsma, S. (FOM-Instituut voor Atoom-en Molecuulfysica, Amsterdam). Plasma Phys.; 14: No. 4, 420-2(Apr 1972).

It is shown that the use of a saddle-point method can lead to the determination of criteria for distinguishing between absolute and convective instabilities in a one-dimensional linear infinite system. (UK)

47162 FLUTE MODES IN A PLASMA IN THE PRESENCE OF NONUNIFORM ELECTRIC FIELDS. Carenza, L.; Engelman, F. (EURATOM-CNEN, Rome). Nuovo Cim.; 10B: No. 1, 127-43(11 Jul 1972).

The effects of the presence of a nonuniform electric field on the stability of flute modes in a plasma are studied in the approximation of small Larmor radius. Most of the work is concerned with discussing and applying to the corresponding eigenvalue problem a step approximation for the profiles of the electric and diamagnetic drifts. Furthermore, a new sufficient stability criterion for flute modes is formulated. The influence of the drifts on the stability properties of the flute modes is discussed, and, in particular, the stabilizing effect of a density gradient is displayed. (auth)

47163 STATISTICAL THERMODYNAMICS OF COLLISIONLESS PLASMA. I. THE THERMODYNAMICAL POTENTIALS. Minardi, E. (EURATOM-FOM, Jutphaas, Netherlands). Plasma Phys.; 14: No. 5, 427-41(May 1972).

It is shown that the equilibria and the stability of nonMaxwellian inhomogeneous plasma can be described by a theory with a thermodynamical structure, provided that, in the linearly unstable cases, the perturbation modes under consideration are not too far from marginal stability. On the one hand, variational functionals prove to exist which can characterize the equilibrium and its stability by means of their extremum properties; on the other hand, a statistical model is proposed from which the same functionals can be derived in an independent way. (UK)

47164 STATISTICAL THERMODYNAMICS OF COLLISIONLESS PLASMA. II. STABILITY THEORY OF INHOMOGENEOUS SYSTEMS. Minardi, E. (EURATOM-FOM, Jutphaas, Netherlands). Plasma Phys.; 14: No. 5, 443-8(May 1972).

The statistical model developed in Part I is applied to the discussion of the stability of inhomogeneous Vlasov equilibria. The existence of instability is expressed by a general condition provided a certain class of variations compatible with the physical constraints imposed on the system does exist. It is also shown, by means of the entropy principle, that the isolated inhomogeneous collisionless systems evolve towards more homogeneous equilibria, associated with a higher entropy, by transforming their collective energy into the energy of the random individual fluctuations. Moreover, nearly homogeneous but electrostatically unstable collisionless plasmas prove to evolve towards the marginal state of the stable equilibrium (which is a state of maximum entropy for the collisionless systems), while an electrostatic quasi-static marginally unstable mode with long wavelength appears in the system. (auth)

47165 MICRO-INSTABILITIES OF HIGH PRESSURE PLASMA ASSOCIATED WITH DEPENDENCE OF THE ION VISCOSITY ON THE DERIVATIVES OF THE LONGITUDINAL THERMAL FLUX. Mikhailovskii, A. B.; Tsypin, V. S. (Inst. of Atomic Energy, Moscow). Plasma Phys.; 14: No. 5, 449-59(May 1972).

Microinstabilities of an inhomogeneous, collisional, high-pressure plasma are investigated. Attention is paid mainly to perturbations with large longitudinal wave numbers, for which the longitudinal ion viscosity is significant. It is shown that for large plasma pressure, the derivatives of the longitudinal thermal flux must be included in the expressions for ion viscosity. Effects of the ion viscosity lead to instability of high-pressure plasma, both in the absence of a magnetic field gradient and when it is oriented in the same direction as the density gradient. (auth)

47166 DRIFT-KINETIC EQUATION AND ELECTROSTATIC INSTABILITY THEORY IN TOKAMAK PLASMAS. Cheung, Lung. Austin, Tex.; Univ. of Texas (1971). 139p. University Microfilms Order No. 72-19,569.

Thesis.

Approximate solutions are obtained to the Vlasov equation that are valid under the conditions that the particle gyro-motion is on a small scale compared to the macroscopic scale. Stability theory of drift modes in a nonuniform, collisionless plasma in the Tokamak confinement geometry is discussed. The stability theory developed substantially generalizes previous systematic treatments given for the plane-slab geometry and the closed-field-line multipole geometry. In particular, the stability of a Maxwellian distribution with a density gradient and a toroidal current is considered in detail. The modified stability criteria and growth rates for the modes are found. (TSS) (Diss. Abstr. Int., B)

47167 EQUILIBRIUM AND STABILITY THEORY OF NONNEUTRAL PLASMAS. Bogema, Bernard LeRoy. College Park, Md.; Univ. of Maryland (1972). 123p. University Microfilms Order No. 72-18,882.

Thesis.

Equilibrium and stability properties of magnetically confined nonneutral plasmas are studied theoretically. Cold-fluid equilibria are constructed in the relativistic and nonrelativistic regimes, exhibiting a variety of density profiles. Electromagnetic perturbations about nonrelativistic equilibria are considered for the ordinary and extraordinary modes of polarization. For constant-density plasmas, the perturbed fields are determined. Electrostatic surface waves on finite-radius columns are studied. Special attention is directed to the case that the plasma has two components rotating at different velocities. In this case, instability may develop for sufficiently high density. Finite-temperature effects are included through a Vlasov description of nonneutral plasmas. The distribution function is assumed to depend on perpendicular energy $H_\perp$ and angular momentum L through the linear combination $H_\perp - \omega_R L$, where ω_R is a constant. The corresponding equilibria rotate rigidly in the mean about the axis of symmetry with angular velocity ω_R. In the nonrelativistic limit, a necessary and sufficient condition for radial confinement is derived, and it is shown that the perpendicular distribution function $\int dp_z f^0(H_\perp - \omega_R L, p_z)$ may be obtained from the equilibrium density profile. The equilibrium equations appropriate to relativistic rigid rotors are also presented. Examples of equilibria are given in both the nonrelativistic and relativistic regimes. Stability of small amplitude electrostatic perturbations about nonrelativistic Vlasov equilibria is considered, emphasizing finite radius effects. Body waves are derived for small temperature and temperature corrections are given for surface waves. A dispersion relation is obtained in the case that the plasma is composed of two equi-density electron beams counterstreaming along the external magnetic field $B_0\hat{z}$. An unstable region of k_z is found that exists only for finite column radius. Finally, an analogue of the Rostoker equation is derived for stable nonneutral plasmas, and quasi-linear equations are developed for weakly unstable systems. (Diss. Abstr. Int., B)

47168 EFFECTS OF PARALLEL WAVELENGTH ON THE COLLISIONAL DRIFT INSTABILITY. Schlitt, Leland Glenn. Princeton, N. J.; Princeton Univ. (1972). 88p. University Microfilms Order No. 72-18,787.

Thesis.

An extensive investigation of the dependence of drift-wave

characteristics upon parallel wavelength in collisional potassium Q-machine plasmas is presented. The experiment was performed on the Princeton Q-1 device modified to permit variation of plasma column length (L = 15 to 135 cm) and thus parallel wavelength ($\lambda_{||} \approx 2L$ under "electron-rich" conditions; $n_0 = 10^{10}$ to 2×10^{11} cm^{-3}, $T_e = 2650$°K). Results are compared with a two-fluid slab-model theory which includes the effects of parallel resistivity and thermal conductivity for electrons and Larmor radius, collisional viscosity, and motion parallel to the magnetic field for ions. The general-stability characteristics of the drift wave are confirmed: stability at low magnetic field ($B/k_\perp \lesssim 0.4$ kG-cm) due to ion viscosity, stability at both long and short parallel wavelength ($\lambda_{||} \gtrsim 200$ and $\lambda_{||} \lesssim 100$ cm, respectively) due to the combined effects of ion viscosity and parallel electron fluid expansion, and stability of individual modes at high magnetic field ($B/k_\perp \approx 1$ kG-cm, $\lambda_{||} \approx 100$ cm) due to ion parallel motion. In addition, quantitative agreement between experiment and theory to within a factor of 2 is demonstrated for the detailed parametric dependences of drift-wave properties (instability onset, complex frequency, and oscillation amplitude) on parallel wavelength, magnetic field, and density. (Diss. Abstr. Int., B)

47169 THRESHOLD OF IONIZATION INSTABILITY IN AN UNBOUNDED LOW TEMPERATURE PLASMA. Zampaglione, V. (CNEN, Frascati, Italy). Plasma Phys.; 14: No. 6, 664-6(Jun 1972).

The complete dispersion relation for ionization waves propagating in an unbounded low-temperature plasma is analytically solved by neglecting the electron pressure term in the Ohm's Law solution, together with the heat convection in the electron energy equation. Within this limit it is found that the threshold of ionization instability does not depend on the relaxation rates within a broad range of operating conditions for the MHD energy conversion method. (UK)

Thermonuclear Processes

Refer also to abstract: 45433.

47170 (IPP-IV-32) POWER PRODUCTION COSTS AND POSSIBLE APPLICATIONS OF SHORT-PERIOD COMBUSTION MHD GENERATORS. Buende, R.; Helm, S.; Muntenbruch, H. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Jan 1972. 58p. (In German). Dep. NTIS (U. S. Sales Only).

Possibilities of applying kerosene–oxygen fired MHD plants for fusion experiment power supply and for reserve power production in industrial and public grids were investigated. Costs of power generation by a plant that can reach its full load only 0.3 to 0.5 sec after being started, and that can vary its load with a time constant of about 10 ms, were determined. As to the power supply of fusion experiments (tokamaks and stellarators), this type of MHD generator will cover quite well present and future requirements, and it may lead to an important reduction of energy costs. Concerning public and industrial grids, this MHD plant is suited to short-period reserve power production required to prevent breakdown of the grid in the event of a sudden shutdown of a unit. When this plant is only operated up to about 100 hours per year, the total power generation costs per year are considerably lower than those incurred by other reserve-power-supply methods. (auth)

47171 EXPERIMENTS ON A SUPERPOSED FIELDS THETA PINCH. Bono, R.; Costa, S.; Mondino, P. L.; Rostagni, G. (Univ., Padua). Plasma Phys.; 14: No. 5, 553-70(May 1972).

The so-called "superposed fields" or "sustained-field" technique, as applied to a theta pinch is described, and a series of experiments performed in order to compare its characteristics with those of a simple theta-pinch are discussed. The desired magnetic field waveform is obtained by means of two coaxial coils, one fed by a steady, or quasi-steady current, the other by a pulsed one. The geometrical field shape is a function of the current ratio and maps for different conditions are shown. Discharges in hydrogen between 10 and 200 mtorr and in helium between 50 and 400 mtorr have been studied and the main results are reported. The influence of a preionizing axial discharge on plasma behavior is also discussed. (UK)

47172 THERMONUCLEAR COMBUSTION WAVES IN A BOUNDED PLASMA. Nastoyashchii, A. F.; Shevchenko, L. P. At. Energ. (USSR): 32: No. 6, 451-5(Jun 1972). (In Russian).

Existence conditions and propagation velocity of a thermonuclear combustion wave in an infinite layer of a plasma confined by walls of heavy material are studied. Two methods are considered: 1) finding approximate analytical solutions for "cold" and "hot" regions and joining the solutions; 2) the phase plane method. It is shown that a combustion wave occurs only in a region of densities and temperatures where the temperature derivative of the effective heat source, including the thermal effect of the fusion reaction thermal losses on the walls and plasma radiation, is negative. (auth)

47173 BREEDING RATIO, INVENTORY, AND DOUBLING TIME IN A D–T FUSION REACTOR. Vogelsang, W. F. (Univ. of Wisconsin, Madison). Nucl. Technol.; 15: No. 3, 470-4(Sep 1972).

A simple model is proposed to investigate the relations between breeding, inventory, and doubling time in the blanket of a fusion reactor using the $T(D,n)He^4$ reaction. It is assumed that the amount of tritium removed per unit time is proportional to the amount present, and the effects of radioactive decay are included. A series of numerical calculations were made using parameters appropriate for a 5000 MW_{th} reactor. From these calculations it appears that, to keep the blanket inventory and the initial inventory for startup to reasonable values, the tritium removal system must be designed to provide a mean tritium residence time in the blanket less than ~1 day, preferably with the mean residence time approaching 0.1 day. Breeding ratios in the range of 1.02 to 1.1 give acceptable doubling times and, in general, higher breeding ratios are not desirable, especially when considered from a hazards viewpoint. (auth)

47174 CONTROLLED-FUSION REACTOR. Stix, Thomas H. (to United States Atomic Energy Commission). U. S. Patent 3,663,362. 16 May 1972. Filed 22 Dec 1970.

Method and apparatus for plasma confinement and/or heating in a toroid-like magnetic system is described, wherein a dense electron-rich sheath is maintained between the surface of a toroid-like body of quasi-neutral plasma and an adjacent conducting wall or grid in order to create a deep electrostatic potential well for the ions of said quasi-neutral plasma and thus to enhance the confinement of ions in said system and/or to accelerate injected ions for the heating of said plasma. (Official Gazette)

47175 PROTON E-LAYER ASTRON FOR PRODUCING CONTROLLED FUSION REACTIONS. Christofilos, Nicholas C. (to United States Atomic Energy Commission). U. S. Patent 3,664,921. 23 May 1972. Filed 16 Oct 1969.

High-energy charged particles (molecular ions) are injected and trapped in a linear axial magnetic mirror containment field to produce a cylindrical E-layer of relativistic ions, e.g., protons rotating about the axis of said field. The magnetic field of the E-layer interacts with the mirror field to produce a pattern of closed magnetic field lines defining a charged-particle containment zone into which neutral fuel materials may be introduced to be ionized by interaction with the E-layer particles forming a high-temperature gas or plasma therein. (Official Gazette)

47176 NEUTRONICS CALCULATIONS FOR TOROIDAL THERMONUCLEAR REACTOR BLANKETS CONTAINING IRON. Smith, Jay Edward. Pittsburgh; Carnegie-Mellon Univ. (1972). 266p. University Microfilms Order No. 72-17,884.

Thesis.

A method is developed for determining the true angular dependence of source neutrons entering the blanket region of a thermonuclear reactor of arbitrary shape. Application of this method is made to various specific geometries including the toroidal tokamak for which the effect of exact angular source distribution on blanket neutronics calculations is estimated by means of a synthesis technique. The feasibility and effects of including discrete amounts of iron within the blanket region are investigated for several possible reasons, including the reduction of required lithium pumping power. The neutron source treatment and synthesis technique mentioned above are used to estimate the effects of iron addition to the blanket of a tokamak reactor. (Diss. Abstr. Int., B)

47177 NUCLEAR FUSION DEVICE OF THE AIR-CORE TOKAMAK TYPE. Yoshikawa, Shoichi (to United States Atomic Energy Commission). U. S. Patent 3,663,361. 16 May 1972. Filed 17 Feb 1970.

An air-core tokamak, having high symmetry, is described for providing an increased ratio of plasma radius over the major radius, stability, high-B, and minimizing field error, as well as a low aspect ratio, high accessibility to the plasma, and separation of the plasma column from the proximity of the material of the vacuum container wall and limiters. The toroidal confinement device has an air-core toroidal solenoid disposed along the inside diameter of the plasma column for producing a toroidal electric field, and spaced apart, toroidal conductors disposed along the outside diameter of the plasma column for compensating for the

return flux of said solenoid and providing a transverse magnetic field for stably confining the plasma. (Official Gazette)

47178 ALL-METAL DISCHARGE TUBE. Phillips, James A.; Schofield, Aldred E.; Briscoe, William L. (to United States Atomic Energy Commission). U. S. Patent 3,667,059. 30 May 1972. Filed 9 Mar 1971.

In a fast linear or toroidal zeta-pinch device, a discharge tube that fits precisely into the primary winding of the device is described. The tube is a series of anodized aluminum rings stacked upon each other and held together by a nonconducting epoxy layer, which is coated with a slightly conducting layer, and then an outer structural layer. (Official Gazette)

47179 FUSION REACTORS. Hancox, R. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Aust. Elec. World: 37: No. 5, 14-20(10 May 1972).

Technological advances towards fusion reactors are described and some conceptions of future fusion systems are forwarded. The engineering of large and complex magnetic systems with average fields of 75 kG peaking to 150 kG with improvement in critical current densities may be required. Structural materials capable of withstanding high neutron doses without damage require development, and other advances that may be crucial for the success of fusion reactors are: refueling of a magnetically contained plasma, control of a reacting plasma, and removal of escaping plasma and reaction products. First-generation reactors are likely to be fueled with deuterium and tritium, which is bred in the nuclear blanket by lithium disintegration. At any time the amount of fuel present in the plasma would be sufficient for only a few seconds operation. (UK)

Wave Phenomena

Refer also to abstracts: 46313–46315, 46318, and 47118.

47180 SPONTANEOUS EMISSION OF PLASMA WAVES IN THE PRESENCE OF A FINITE-AMPLITUDE WAVE. Katayama, Yoshishige (Kyoto Univ.). J. Phys. Soc. Jap.; 33: No. 2, 483-95(Aug 1972).

The spontaneous Cherenkov emission of longitudinal waves in a plasma with small but finite amplitude wave (hereafter referred to as the carrier wave) is investigated. Two effects of the carrier wave are taken into account; one is the modification of the test-particle orbit and the other that of the dielectric character of the plasma. It is shown that particles trapped in the potential-energy troughs of the carrier wave emit a discrete spectrum of sideband waves (in addition to the carrier wave itself) whose frequencies are different from the carrier-wave frequency by approximately integral multiples of the bounce frequency. An untrapped particle also emits waves at several different frequencies, including the one which satisfies the ordinary Cherenkov condition, but these frequencies depend on the particle velocity. The results are compared with those reported in a previous paper where only the effect of the orbit modification is taken into consideration. (auth)

47181 NONLOCAL DRIFT WAVES IN A CYLINDRICAL PLASMA. Midzuno, Yukio (Nagoya Univ., Japan). J. Phys. Soc. Jap.; 33: No. 2, 502-10(Aug 1972).

Propagation characteristics of nonlocal drift waves in a cylindrical plasma are investigated on the basis of two-fluid model composed of cold ions and warm electrons. An equation is derived for describing the radial behavior of the wave amplitude. The dispersion relation is obtained from solutions of an eigenvalue problem, and the latter is proved to have a unique solution if the radial density is moderate and the mode numbers are prescribed. The eigenvalue problem is solved numerically for a density profile of a Gaussian type, for which the drift frequency ω_* can be defined unambiguously. It is found that the dispersion relation obtained in the conventional slab approximation is a good approximation to the one of a cylindrical plasma, provided that the drift frequency ω_* is much smaller than the ion cyclotron frequency. (auth)

47182 NUMERICAL SIMULATION OF THE EVOLUTION OF AN EXCITED MONOCHROMATIC WAVE IN A ONE-DIMENSIONAL MAXWELLIAN PLASMA. Lorente, Ambrosio (Univ. Paris, Orsay, France). Compt. Rend., Ser. B; 274: No. 18, 1057-60 (3 May 1972). (In French).

A one-dimensional Maxwellian electron plasma was simulated using electron packets (whose electric charge and dimension were defined from the density of the initial plasma) and a uniform cloud of stationary ions. The existence of a Landau damping of waves initially excited was established together with the nonlinear effects due to trapping. (France)

47183 KINETIC ANALYSIS OF COLLISION EFFECTS ON NONLINEARITIES RELATED TO ELECTROMAGNETIC WAVE PROPAGATION IN A WEAK DISSIPATIVE-IONIZED MEDIUM. Jancel, Raymond (Univ., Paris). Compt. Rend., Ser. B; 274: No. 18, 1061-4(3 May 1972). (In French).

A kinetic method for studying the effect of collisions on nonlinearities in weakly or partially ionized plasmas is proposed. Effects related to electromagnetic-wave propagation such as generation of harmonics and mode coupling are investigated in particular. (France)

47184 CYCLOTRON HARMONIC WAVES IN A REFLEX DISCHARGE. Brand, G. F.; Cohen, D. D. (Univ. of Sydney). Plasma Phys.; 14: No. 5, 571-4(May 1972).

An experiment to examine the dispersion relation for cyclotron harmonic waves in a reflex discharge revealed a large effect due to the nonMaxwellian electron velocity distribution. The wavelengths were several times shorter than those predicted by Bernstein's dispersion equation. (auth)

47185 NONLINEAR FOCUSING OF TM WAVES IN ISOTROPIC PLASMA. Demchenko, V. V.; Hussein, A. M. (Atomic Energy Establishment, Cairo). Plasma Phys.; 14: No. 4, 417-18(Apr 1972).

The self-focusing properties of small-amplitude waves in isotropic plasma are considered. It is shown that, if the dielectric constant varies with the wave amplitude, a waveguide channel is formed and maintained by the electromagnetic wave pressure. (UK)

47186 GENERATION OF SHOCK WAVES BY EXPLODING CURRENT SHEATH. Kc nel'kov, V. S.; Modzolevskii, V. I. JETP Lett. (USSR) (Engl. Transl.); 15: No. 6, 210-12(20 Mar 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 6, 299-301(20 Mar 1972).

A dense plasma was accelerated in strong magnetic fields and in short nozzles. When the magnetic piston reaches the end of the nozzle, a unique explosion-like rapid expansion of the current sheath occurs and strong shock waves are produced. Some experimental results are given. (M.O.W.)

47187 PARAMETRIC AMPLIFICATION OF ALFVEN WAVES. Lehane, J. A.; Paoloni, F. J. (Univ. of Sydney). Plasma Phys.; 14: No. 5, 461-71(May 1972).

Observation of the amplification of Alfvén waves launched into a perturbation region is reported. The effect was found to depend on the relative frequencies of the wave and the perturbation field, on the strength of the perturbation field, and on the phase of the wave entering the perturbation region. (UK)

47188 CYCLOTRON HARMONIC WAVES IN AN INHOMOGENEOUS PLASMA. I. THEORY. Derfler, H.; Leuterer, F. (Max-Planck-Insitut fuer Plasmaphysik, Garching, Ger.). Plasma Phys.; 14: No. 5, 473-97(May 1972).

The Buchsbaum–Hasegawa equation describing the rf electric field within a one-dimensional magnetoplasma slab is derived from first principles. In a laboratory plasma the electron collisions are sufficiently numerous, in which case one can ignore the multiple reflection of the waves between the hybrid layers, and describe the electric field by two propagating waves alone. (UK)

47189 CYCLOTRON HARMONIC WAVES IN AN INHOMOGENEOUS PLASMA. II. EXPERIMENT. Leuterer, F. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Plasma Phys.; 14: No. 5, 499-521(May 1972).

Electrostatic cyclotron harmonic waves were excited in an inhomogeneous plasma column with axial magnetic field by means of an externally applied rf capacitor field. Amplitude and phase of the rf potential inside the plasma were measured with a probe. For frequencies just above the harmonics of the electron cyclotron frequency, forward waves were found in the low density region of the plasma where the local density is less than the hybrid density. For frequencies just below the harmonics, backward waves were found in the dense core of the column. Time-of-flight measurements show that both the forward and the backward waves are excited around the hybrid layers. Multiple reflection of backward wave trains at the hybrid layers was observed. (UK)

47190 PARAMETRIC COUPLING BETWEEN ELECTRONIC AND IONIC WAVE MODES IN AN AUTO-RESONANT PLASMA. Leprince, P. (Laboratoire de Physique des Plasmas, Orsay, France). Plasma Phys.; 14: No. 5, 523-41(May 1972). (In French).

The experimental results in a low-pressure rf self-sustained plasma discharge are discussed. A parametric coupling between several electronic modes with different azimuthal wavenumbers and an ionic mode are seen to explain one of the emissions whose

frequency lies close to ionic plasma frequency. This oscillation is also observed when the exciting frequency lies close to the thermal Tonks–Dattner resonances (secondary resonances) frequencies in a low-pressure glow discharge. (UK)

47191 LONGITUDINAL WAVES IN PLASMAS AND PHYSICAL MECHANISM OF LANDAU DAMPING. Lacina, J. (Inst. of Plasma Physics, Prague). Plasma Phys.; 14: No. 6, 605-16(Jun 1972).

Expressions for the kinetic energy and the kinetic momentum of longitudinal waves are derived including the nonlinear motion up to second-order in the perturbation. The Landau dispersion equation is then derived from the energy–momentum conservation laws. It is shown that the effect of the electric field of a wave on the motion of particles results both in quasi-harmonic oscillations (damped or growing) and in the changed value of uniform motion. (UK)

47192 MODIFIED ORDINARY WAVE. Arumi, F. N.; Oakes, M. E. (Univ. of Texas, Austin). Plasma Phys.; 14: No. 6, 635-49(Jun 1972).

The modified ordinary wave in the presence of contrastreaming beams is studied using a macroscopic model which, through the use of a pressure tensor, includes perpendicular temperature of the beams. Regions of instability are determined and growth rates given. (auth)

47193 EXPERIMENTAL STUDY OF WAVE–WAVE COUPLING PROCESSES IN A BEAM–PLASMA SYSTEM. Chang, James Shih-tsih. Urbana, Ill.; Univ. of Illinois (1972). 92p. University Microfilms Order No. 72-19,806.

Thesis.

The wave–wave coupling processes in a cold-beam cold-plasma system were investigated under conditions such that nonlinear wave–particle effects are negligible. In this experiment, a low-density mono-energetic beam in the energy range of 15 to 16 keV was premodulated at two frequencies, f_0 = 9.5 GHz and f_1 = 9.4 GHz and injected into the afterglow of a discharge in neon. The interaction between these two launched waves and their difference frequency, f_2, was investigated and at low wave amplitudes was found to be in general agreement with the theory of the three-wave decay instability. At larger wave amplitudes, a strong remixing of the three waves occurred, giving rise to "satellite waves" at frequencies $f_0 \pm nf_2$ and $f_1 \pm nf_2$, where n is an integer. Measurements of the spatial evolution of these satellite waves and their dependence on the modulation power and difference frequency are presented. The results are discussed in the light of the theory of coupling among spatially growing waves. (Diss. Abstr. Int., B)

47194 INVESTIGATION OF LOW-DENSITY PLASMA SHOCK WAVES IN AN EXPANDING DISCHARGE. Davis, Harold Alan. San Diego, Calif.; Univ. of California (1972). 166p. University Microfilms Order No. 72-19,718.

Thesis.

Plasma waves launched into a low-density, photoionized, magnetized, argon plasma were studied. The shock waves were generated by an inverse pinch discharge, an expanding discharge as opposed to the more conventional contracting discharges normally used to study shock waves. The driving current of this device initially flows in the region near the insulator, which is transiently filled with a relatively high density (30 m torr) of neutral gas just prior to the initiation of the discharge. As this current layer expands, it acts as a piston, driving shocks into the low-density region ahead of it. The low-density region contains a uniform 2-m torr fill of neutral argon which is 30% photoionized (2×10^{13} electrons/cm^3) by the intense radiation from the plasma associated with the piston. Initially, the experimental volume is filled with a uniform axial magnetic field of 500 G. The diagnostic techniques employed included Kerr-cell photography of the plasma luminosity, magnetic and floating electric probing, Thomson scattering of ruby laser light at low α to obtain both electron temperature and density, and the measurement of spectroscopic line-intensity profiles to infer ion velocities. Magnetic probe data indicated that a conventional Mach 2 shock, well separated from the driving field having a compression ratio of 2, was generated. However, the scattering measurements showed that the electron temperature was too low and the electron density rise across the shock was too high for the observed propagating magnetic field jump to be a conventional plasma shock. Subsequent line-intensity profile measurements showed that a component of the plasma was moving at shock speed. This led to the development of a new model. In this model, a beam of twice-ionized argon ions moves ahead of the piston and carries some electrons with it in order to preserve space-charge neutrality. This produces the observed electron density rise. Since the electrons are tightly coupled to the magnetic field, magnetic flux is carried with the ion beam producing the observed rise in the magnetic field. The origin of the ion beam was investigated by calculating the trajectories of ions, starting at various radii, using the measured radial electric field. The calculation demonstrated that the fast ions originated near the insulator and were not the result of specular reflection from the piston field, whose current sheet boundary moved at exactly half shock speed. In addition, the stability of the ion beam moving through the ionized stationary background was investigated (the ion mean free path due to Coulomb collisions was very large). The beam was found to be stable. This result was compared with the theory of interpenetrating ion beams in a magnetic field, and was found to agree for the conditions of this experiment. (Diss. Abstr. Int., B)

47195 STRUCTURE OF THE PLASMA-WAVE ECHO. Goforth, Robert Ronda. Austin, Tex.; Univ. of Texas (1971). 86p. University Microfilms Order No. 72-19,591.

Thesis.

Electron plasma wave echo experiments are described in which the observed structure of the echo is in good agreement with the theoretical description from the Vlasov equation. The theory is extended to third order for comparison with the experiment. Measurements of the spatial periodicity and envelope of the third-order echo are in good agreement with the extended theory. Electron plasma wave echoes of second order were experimentally studied in a two-density plasma, and the observed structure compares favorably with theory. Because the observed structure contains information about the primary waves, these experiments demonstrate the reversibility of Landau damping. (Diss. Abstr. Int., B)

47196 STRUCTURE OF A LARGE-AMPLITUDE STATIONARY HYDROMAGNETIC DISTURBANCE IN A COLLISIONLESS PLASMA. Mahdavi, Mohamad Ali. San Diego, Calif.; Univ. of California (1972). 157p. University Microfilms Order No. 72-19,720.

Thesis.

Structure of a shock-like hydromagnetic disturbance in a collisionless plasma was studied. The current sheet of an Inverse Pinch Discharge driven into a low-density magnetized plasma was used to generate the shock wave. Argon at a static pressure of 2×10^{13} torr was used as a filling gas. A certain amount of argon gas was puffed into the discharge region prior to firing of the energy banks to ensure uniform breakdown of the gas. Preionization of the low-density ambient gas was achieved by intense uv radiation from the piston plasma (current sheet of the pinch). Diagnostic techniques used were electric and magnetic field probes, light scattering and spectroscopy. Electron densities and temperatures in the post and pre-shock regions were measured by light scattering. Streaming velocities of the ions were determined by the measurement of Doppler shift of spectral lines. Electron temperature in the post-shock plasma was also determined by the ratio of spectral line intensities. A stationary shock-like structure of velocity of 10^7 cm/sec propagates into undisturbed plasma of 2×10^{13} el/cm^3 and ambient transverse magnetic field of 500 G. The experimentally measured plasma parameters do not fit the De Hoffman–Teller jump conditions. The explanation offered for this violation is presence of a beam of fast ions emerging from the magnetic piston in the upstream direction. Doppler shift of spectral lines showed presence of ions traveling at the shock velocity. The plasma associated with the piston and the ion beam was primarily double ionized. Measured electron temperature in the post-shock plasma is ≈3 eV. An upper bound set on the ion temperature is ≈300 eV. (Diss. Abstr. Int., B)

47197 ELECTRICAL SHOCK-TUBE PRECURSOR. Mills, James Ignatius Jr. Norman, Okla.; Univ of Oklahoma (1972). 104p. University Microfilms Order No. 72-19,020.

Thesis.

Observations of luminosity and ionization far in advance of the plasma-acoustic expansion in electrically driven shock tubes have been made by many investigators, and the conflicting results and explanations of these studies have led to much confusion. The results described in this dissertation clarify the situation. Precursor waves were created and studied in helium by means of an electrically driven shock tube employing two different discharge-circuit configurations. The component causes of precursive effects were separated and identified and studied individually in detail. Parameters of basic interest such as wave speed and electron temperatures and densities were monitored, using nuclear data handling techniques and photomultipliers for the wave speeds and a revised spectral-line-ratio technique for the temperatures and densities. Velocities of the order of 10^8 to 10^9 cm/sec were recorded. Electron temperatures of 10 eV and electron densities ranging from 10^9 to 10^{10} el/cm^3 were observed. Exten-

sive studies employing the use of a magnetic field were conducted in order to gain insight into the thermal conduction processes acting to transfer energy to the wave front. Many investigations of the electrical properties of the wave including the use of external calibrated probes to measure the electric field strengths associated with the front were undertaken. A discussion of the bearing this new knowledge has on explaining past studies as well as planning future studies with the electrical shock tube is included. (Diss. Abstr. Int., B)

47198 STUDY OF THE STRUCTURE OF COLLISIONLESS SHOCK WAVES PROPAGATING PERPENDICULAR TO AN INITIAL FIELD. Phillips, Perry Edward. Austin, Tex.; Univ. of Texas (1971). 137p. University Microfilms Order No. 72-19,648.

Thesis.

An experimental study of the structure of collisionless shock waves was carried out on the oblique shock apparatus at the University of Texas. A brief review of the structure of shock waves is presented, starting from ordinary gasdynamic shocks and progressing to the structure of collisionless shock waves. Calculations of the effects of various dissipative mechanisms on the shock thickness were performed. A comprehensive experimental study of the structure of low- to intermediate-strength shocks was conducted. Special emphasis was placed on understanding the double structure previously observed in shocks for low-β plasmas. The apparatus produced shocks with Alfven Mach numbers from 2 to 6, which propagated into a preheated plasma with a density of $\sim 5 \times 10^{14}$ cm^{-3} and equal electron and ion temperatures of 1 eV. The initial plasma is collision-dominated; however, due to heating in the shock frame, collisionless conditions are rapidly produced. A novel magnetic probe was used to examine in detail the magnetic structure of the shock waves moving perpendicular to the field. The familiar double structure, or foot, was observed above the so-called critical Alfven Mach number $M_A^* \approx 3$. A double structure, involving a pronounced change in slope, was also observed below M_A^*. Using a two-fluid MHD model it is shown that the latter can be explained in terms of a transition from classical to collisionless resistivity within the shock front. The observed foot structure above the critical Mach number was consistent with the concept of ions being reflected from the shock front and executing gyro orbits out ahead of the shock. For verification of this hypothesis two methods of detecting the presence of reflected ions were attempted. First spectroscopic measurements of the Hα line profiles were performed. For shocks with Mach numbers above M_A^*, they exhibited a significant amount of radiation out at a Doppler-shifted frequency corresponding to ions traveling at twice the shock velocities. This excess radiation was not observed for Mach numbers below M_A^*. A direct measurement of the reflected ion current was obtained by a modified ion probe. These measurements were compared with a model proposing the link between the reflected ions and the observed foot structure. Excellent agreement was achieved. A model for the reflecting mechanism is also proposed which can explain the importance of the critical Mach number and is not in contradiction to the experimental data. From this work it can be concluded that ions are reflected from the shock front and that they are the cause of the double structure observed in shock waves for $M_A > M_A^*$. (Diss. Abstr. Int., B)

47199 INFLUENCE OF REFLECTED IONS ON THE MAGNETIC STRUCTURE OF A COLLISIONLESS SHOCK FRONT. Phillips, P. E.; Robson, A. E. (Univ. of Texas, Austin). Phys. Rev. Lett.; 29: No. 3, 154-7(17 Jul 1972).

A special probe was used to detect ions reflected from a collisionless shock wave propagating perpendicular to the field in a magnetized, low-β plasma. Reflected ions are observed only above a critical Alfvén number $M_A \approx 2.7$, and their orbits coincide with the familiar "foot" on the magnetic structure of supercritical shocks. The origin of the reflected ions is discussed. (auth)

47200 EFFECT OF THERMAL CONDUCTIVITY ON THE STRUCTURE AND CRITICAL PARAMETERS OF SHOCK WAVES IN A PLASMA. Berezin, Yu. A.; Dudnikova, G. I. Zh. Prikl. Mekh. Tekh. Fiz.; No. 2, 8-14(1972). (In Russian).

Results are given from a numerical solution to the problem of propagation of shock waves in a cold, rarefied plasma across a magnetic field in the presence of a finite conductivity and electronic thermal conductivity. The results are compared with those obtained neglecting thermal conductivity. At small Mach numbers ($M < 2.5$) it is possible to disregard the thermal conductivity. At Mach numbers of $2.8 \lesssim M \lesssim 3.3$, an isomagnetic discontinuity in density is obtained. An increase in the amplitude of the magnetic field at the plasma boundary leads to a dissolution of the isomagnetic discontinuity. The critical Mach number characterizing the shock wave is $M^* > 3.4$. (tr-auth)

47201 EXCITATION OF A REGULAR PLASMA WAVE BY A MODULATED BEAM WITH HIGH ENERGY DENSITY. Krasovitskii, V. B. (All-Union Research, Desing, and Technological Inst., Moscow). JETP Lett. (USSR) (Engl. Transl.): 15: No. 6, 244-7(20 Mar 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 6, 346-9(20 Mar 1972).

Investigations were made of the interaction of a relativistic beam with a nonlinear plasma, which point to the possibility of synchronism between the beam and the wave during the nonlinear stage of instability development if the beam and plasma parameters are so chosen that the beam velocity and the phase velocity of the wave decrease with time in accordance with an identical law. In this case the energy transferred from the beam to the field greatly exceeds the value obtained earlier. (M.O.W.)

47202 SOLITONS IN A TWO STREAM PLASMA. Alikhanov, S. G.; Kichigin, G. N.; Konkasbaev, I. K. (Inst. of Nuclear Physics, Novosibirsk, USSR). Plasma Phys.; 14: No. 6, 661-4(Jun 1972).

The propagation of solitons in a nonisothermal collisionless plasma in the absence of a magnetic field was investigated, in a system consisting of several inter-penetrating ion streams. (UK)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts: 45604, 46359, 46365, 46448, 46854, and 47238.

47203 (N-72-18797) RADIATION DOSIMETRY FOR THE GEMINI PROGRAM. Richmond, Robert G. (National Aeronautics and Space Administration, Moffett Field, Calif. Ames Research Center). Mar 1972. 16p. (NASA-TN-D-6695; MSC-S-222). NTIS.

The principal source of radiation for low-earth-orbit, low inclination space flights is in the area of the South Atlantic magnetic anomaly. None of the Gemini dose measurements reported are of high-enough intensity to be considered hazardous. There is a trend toward larger doses as missions are flown higher and longer. Extended orbital operations between 1400 and 4400 km would encounter high interior radiation levels. Pronounced spacecraft geometry effects were measured in manned spacecraft. Instrumentation for radiation measurements on Gemini spacecraft is described. (auth) (STAR)

47204 INVESTIGATIONS ON ABSOLUTE DIFFERENTIAL SCATTERING CROSS SECTIONS OF 0.662 MeV PHOTONS. Thein Aung (Arts and Science Univ., Rangoon); Thein Htut, Hla Pe; (and others). Union Burma J. Sci. Technol.; 3: No. 1, 245-50(Apr 1970).

Absolute values of the differential scattering cross sections for ^{137}Cs (0.662-MeV) photons were measured in the angular range of 15° to 120°. A uniform-sensitivity photon counter suitable for low-energy photons was used to measure the relative values of the cross sections. The cross sections were then converted to absolute values by measuring incomplete scattering cross section. The experimental values, when corrected for coherent scattering, show good agreement with the Klein–Nishina formula. (auth)

47205 TRANSMISSION OF LOW-ENERGY X-RAY THROUGH VARIOUS LOCALLY AVAILABLE MATERIALS. Lee, H. (Ateneo Univ., Manila); Terrado, J.; Petel, R.; Bustamante, N. Philipp. Nucl. J.; 2: No. 2, 215-22(1970).

The transmission of low-energy x rays through various materials was determined using a Victoreen condenser roentgen meter. Initial calibration of the x-ray unit was done to determine the characteristics of the equipment. The method of least squares was used to obtain a good curve fit on the transmission measurement data. The linear attenuation coefficient of the various materials as a function of the energy of the x-ray beams were determined. (auth)

47206 EFFECTIVE ATOMIC NUMBERS FOR PHOTOELECTRIC PROCESS IN VARIOUS SHELLS IN ALLOYS. Narasimha Raju, M. L.; Chandran, C. R.; Parthasaradhi, K.; Ramamurty, S. (Andhra Univ., Waltair, India). Indian J. Phys.; 45: No. 2, 92-3(Feb 1971).

The effective atomic numbers for various shell effects in three typical alloys: solder (Pb, 67%; Sn, 33%), plumber solder (Pb, 50%; Sn, 50%), and soft solder (Pb, 40%; Sn, 60%) are estimated using procedures described previously and making use of theoretical shell cross sections. It was shown that effective atomic numbers, within the range of errors, can be defined uniquely irrespective of shells and incident photon energy in all the alloys. (M.H.R.)

47207 EFFECTIVE ATOMIC NUMBERS FOR DIFFERENTIAL PROCESSES OF GAMMA-RAY INTERACTIONS. Siddappa, K.; Parthasaradhi, K.; Rama Rao, J. (Andhra Univ., Waltair, India). Indian J. Phys.; 45: No. 4, 184-6(Apr 1971).

Systematic investigations were made on differential effects in photoelectric incoherent and coherent scattering processes. The available theoretical cross sections were used, since there is no adequate accurate experimental data on the differential effects. (M.H.R.)

47208 RANDOM METHOD FOR BOLTZMANN'S EQUATION. Patraulea, N. N. Stud. Cercet. Mec. Apl.; 30: No. 6, 1281-5 (1971). (In Rumanian).

A random method is presented for the solution of the basic equation of rarefied gases. The method is equally applicable to elastic collisions and to any other models of collision laws. Random evaluations of the collision are made over the 8-dimensional interval ($\bar{v}_1$, $\bar{v}_2$, $\bar{P}$) connected to each point of a finite network in the physical space. Satisfactory convergence is mainly based on the lower dispersion in consequence of the selection of the random velocities $\bar{v}$, $\bar{v}_2$ of the waves under consideration with probability density $f/\int f d\bar{v}$. (auth) (Rom. Sci. Abstr.)

47209 FLUORESCENCE PHOTON AND AUGER ELECTRON SPECTRA. Charlton, D. E. (Sir George Williams Univ., Montreal). Radiat. Res.; 50: No. 3, 455-63(Jun 1972).

Empirical formulas giving the fluorescence photon and Auger electron spectra following electron capture and internal conversion as a function of atomic number are presented. Processes originating in the K and L shells only are considered, and these account for approximately 95% of the total energy escaping from the atom. It is suggested that the remaining 5% is probably carried by Auger electrons originating in the M and N shells. The fluorescence photon and Auger electron spectra of tellurium atoms produced by the decay of ^{125}I are evaluated and compared to those of other authors. (auth)

47210 LOW-ENERGY ELECTRON TRANSPORT BY THE METHOD OF DISCRETE ORDINATES. Bartine, David Elliott. Rolla, Mo.; Univ. of Missouri (1971). 108p. University Microfilms Order No. 72-18,186.
Thesis.

The one-dimensional discrete-ordinates code ANISN was adapted to simulate the transport of low-energy (on the order of a few MeV) electrons. Two different calculational techniques were utilized for the treatment of electron–electron collisions that result in a small energy transfer. One method treats such collisions by a continuous slowing-down approximation, while the other method treats these collisions by the use of a very approximate cross section. Calculated results obtained with ANISN are compared with experimental data for the transmitted energy and angular distributions for 1-, 2.5-, 4-, and 8-MeV electrons normally incident on aluminum slabs of various thicknesses and for 1-MeV electrons normally incident on a gold slab. The calculated and experimental results are in reasonably good agreement for the aluminum slabs but are in poor agreement for the gold slab. Calculated results obtained with ANISN are also compared with calculated results obtained with Monte Carlo methods. (Diss. Abstr. Int., B)

47211 DISCRETE-ORDINATES METHODS FOR THE NUMERICAL SOLUTION OF THE TRANSPORT EQUATION. Lathrop, K. D. (Los Alamos Scientific Lab., N. Mex.). Reactor Technol.; 15: No. 2, 107-35(1972).

The theory, advantages, disadvantages, and capabilities of the discrete-ordinates method for numerical solution of the Boltzmann transport equation are reviewed. To illustrate the simplicity of the method, the author derives the theory directly for the specific case of one-dimensional spherical geometry and thereby provides a clearer picture of the method than is available in more general expositions. On this foundation the essential generalizations of the techniques are made. The major limitations of the method, including orthogonal geometries, negative fluxes, ray effects, convergence requirements, and data storage are discussed in detail, and current work to remedy these limitations is reviewed. The capabilities of the discrete-ordinates method are surveyed at length, and numerical programs applying the discrete-ordinates techniques are tabulated and compared. An ancestral chart of current discrete-ordinates programs is provided. A general guide to the usage of discrete-ordinates programs is given, and the application of the method is illustrated in examples including a shielding bench-mark problem, a reactor core-design problem, a control-rod-worth and radiation heating study, a pulsed-neutron problem, and a shielding parameter survey. (66 references) (auth)

47212 CALCULATION OF THE SPECTRA OF ELECTRON ENERGY LOSSES IN GOLD FROM 1 TO 12 eV. COMPARISON WITH THE SPECTRA OBSERVED AT 35 keV. Wehenkel, Claude (Univ., Paris). Compt. Rend., Ser. B; 274: No. 15, 939-42(10 Apr 1972). (In French).

The electron energy loss spectra were calculated from experimental optical constants taking into account propagation effects. The effects of the zero energy loss line and other parameters are discussed. The calculation was compared with experimental spectra obtained on the transmission by a gold layer of known thickness. The agreement is better for the positions of the lines than for their relative intensities. (France)

47213 METHOD OF DETERMINING THE MEAN ENERGY OF SECONDARY ELECTRONS IN ELECTRON EQUILIBRIUM

REGIONS USING THEORETICAL X-RAY SPECTRA (10 TO 20 MV) AND IONIZATION MEASUREMENTS IN DIFFERENT MEDIA. Guille, B.; Martin, P. N.; Bernard, M. (Univ., Limoges, France). Radioprotection; 7: No. 1, 45-51(1972). (In French).

In an x or γ radiation field, the absorbed dose at every point in matter is linked to the ionization produced in an air cavity and to the stopping power relative to the secondary electrons. When particular electron equilibrium conditions are set up, this dose depends also upon the spectral distribution of the incident radiation, the attenuation of the various media traversed, and the coefficient of energy transfer. These two relations enable the mean energy of the secondary electrons resulting from ionization phenomena to be determined. (France)

47214 RADIATSIONNAYA FIZIKA KRISTALLOV I p–n-PEREKHODOV. (Radiation Physics of Crystals and p–n Junctions). Sirota, N. N. (ed.). Minsk; Izdatel'stvo Nauka i Tekhnika (1972). 168p.

Problems in radiation physics of solids, associated with channeling of charged particles of relatively high energy, in crystals of semiconductors are examined in this collection of 21 articles by different authors. Eight papers are concerned with the interaction of radiation with Si and Ge p–n junctions, and the effects of temperature, annealing behavior, and the spectral composition of neutrons. Seven additional papers focus attention on the effects of radiations (fast neutrons, ^{60}Co gamma rays, Si^{-} ions, x rays) on chemical compounds such as GaSb, CdS, Si, ferrites, alkali halides, $KMnO_4$, α-alanine, glycine, and triglycinesulfate. (K.S.W.)

47215 GAMMA QUANTA DISTRIBUTION AT LARGE DISTANCES FROM THE SOURCES. Nikolaishvili, Sh. S.; Gabrashvili, A. I.; Dzhgarkava, N. N.; Iordanishvili, E. A. At. Energ. (USSR); 32: No. 6, 504-5(Jun 1972). (In Russian).

A generalized method is outlined for calculating the distribution of γ quanta and neutrons at arbitrarily large distances from the sources of the original radiation. The generalization touches upon that portion of the method in which the problem is solved with the help of the final number or original momenta. (K.S.W.)

Radiation Protection Standards

47216 NATIONAL STANDARDS FOR PHOTON DOSIMETRY. Guiho, J. P. (CEN de Saclay, Gif-sur-Yvette, France). Radioprotection; 7: No. 1, 3-12(1972). (In French).

A coherent photon dosimetry system of national references was established. Gamma sources (^{137}Cs and ^{60}Co) were used to produce reference photon beams, their decay/time characteristics being determined. The dimensions of the radiation source, the characteristics of the collimator, and the environment were studied. In particular, the effect of the various geometric parameters of the collimator on the spectral distribution of the incident photons was investigated. The exposure due to the photon beams was determined; their energy fluence is currently being investigated. The references for the absorbed dose rates will be defined. (France)

Radiation Source Calibration and Standardization

Refer also to abstract: 45799.

47217 STANDARD BLACK BODY AT 10,000°K (HIGH PRESSURE PLASMA ARC). Peyturaux, R.; Goldbach, C.; Nollez, G. (CNRS, Paris). pp 65-75 of Proceedings of the Meeting on Metrology. Paris; Bureau National de la Metrologie (1971). (In French). (CONF-701151-1).

From Meeting on metrology; Paris, France (17 Nov 1970).

Research was conducted to produce a radiation standard corresponding to temperatures in excess of 5000°K. Theoretical studies postulate that a 10-cm argon plasma subjected to a pressure of 100 bars and brought to a temperature of 10,000°K would radiate as a black body. In order to achieve such conditions, a stabilized arc was developed involving a 5-cm-long plasma operating under a pressure of 50 atm. At atmospheric pressure, the electronic temperature is 1600°K (for dissipated 16 kW). Although the determination of the electron temperature poses problems at high pressures (reabsorption of radiation), it appears that the electron temperature decreases with pressure (for constant dissipated power) while the brightness temperature increases and tends to remain constant over a large spectral range. (France)

47218 EXPOSURE MEASUREMENTS AND SPECTROMETRY IN THE MEDIUM ENERGY X-RAY REGION. Amat, G.; Ambrosi, M. (Laboratoire Central de l'Armement, Arcueil, France). pp 181-8 of Proceedings of the Meeting on Metrology. Paris; Bureau National de la Metrologie (1971). (In French). (CONF-701151-2).

From Meeting on metrology; Paris, France (17 Nov 1970).

Exposure measurements consist of measuring the total charge (of a particular sign) collected as a result of the secondary particles liberated from interactions between photons and a given mass of air. This ionization is measured using a free-air ionization chamber which defines, perfectly, an interaction volume for the photons. In the usual x-ray apparatus, this chamber is the primary instrument employed to measure exposure rates, cavity chambers being used for the transfer of standards. The spectrometry of beams differs from the γ spectrometry of sources in three aspects: the energy distribution of the photon fluence is no longer discrete, but continuous and does not require very high resolution. A very large number of photons penetrate into the spectrometer and the possibility of deforming the initial spectrum must be reduced by diaphragms. The photons penetrate the detector as narrow parallel beams leading to a high detection efficiency. (France)

47219 METROLOGY OF IONIZING RADIATIONS. Le Gallic, Y. (CEN de Saclay, Gif-sur-Yvette, France). pp 175-80 of Proceedings of the Meeting on Metrology. Paris; Bureau National de la Metrologie (1971). (In French). (CONF-701151-3).

From Meeting on metrology; Paris, France (17 Nov 1970).

The metrology of ionizing radiations utilizes three reference units: the Curie, the Roentgen, and the Rad, which define two types of measurement: the metrology of activities, and the dosimetry of radiations. The accuracy obtained in this type of metrology is distinct from that obtained in other metrological disciplines, an accuracy of 10^{-4} being currently sought. It is recalled that the essential factors necessary for an improvement are: purity of the radioisotope; the development of new measurement techniques; knowledge of fundamental parameters; development of national reference standards. Although considerable work has yet to be accomplished, the results already obtained are very encouraging. (France)

Shielding Calculations and Theory

47220 (ORNL-TM-3867) SDT1. IRON BROOMSTICK EXPERIMENT. Maerker, R. E. (Oak Ridge National Lab., Tenn.). Jul 1972. Contract W-7405-eng-26. 20p. (ENDF-166). Dep. NTIS.

The experimental and calculational details for a CSEWG integral data testing shielding experiment are presented. The experiment was designed to test a given set of neutron total cross sections for iron in the range 0.8 to 11 MeV. A FORTRAN package is available to perform all the manipulation described. (M.H.R.)

47221 (ORNL-TM-3868) SDT2. OXYGEN BROOMSTICK EXPERIMENT. Maerker, R. E. (Oak Ridge National Lab., Tenn.). Jul 1972. Contract W-7405-eng-26. 18p. (ENDF-167). Dep. NTIS.

The experimental and calculational details for a CSEWG integral data testing shielding experiment are presented. The experiment was designed to test a given set of neutron total cross sections for oxygen in the range 1.9 to 8.6 MeV. A FORTRAN package is available to perform all the manipulation described. (M.H.R.)

47222 (ORNL-TM-3869) SDT3. NITROGEN BROOMSTICK EXPERIMENT. Maerker, R. E. (Oak Ridge National Lab., Tenn.). Jul 1972. Contract W-7405-eng-26. 18p. (ENDF-168). Dep. NTIS.

The experimental and calculational details for a CSEWG integral data testing shielding experiment are presented. The experiment was designed to test a given set of neutron total cross sections for nitrogen in the range 0.8 to 10 MeV. A FORTRAN package is available to perform all the manipulation described. (M.H.R.)

47223 (ORNL-TM-3870) SDT4. SODIUM BROOMSTICK EXPERIMENT. Maerker, R. E. (Oak Ridge National Lab., Tenn.). Jul 1972. Contract W-7405-eng-26. 18p. (ENDF-169). Dep. NTIS.

The experimental and calculational details for a CSEWG integral data testing shielding experiment are presented. The experiment was designed to test a given set of neutron total cross sections for sodium in the range 0.8 to 11 MeV. A FORTRAN package is available to perform all the manipulation described. (M.H.R.)

47224 (ORNL-TM-3871) SDT5. STAINLESS-STEEL BROOMSTICK EXPERIMENT. Maerker, R. E. (Oak Ridge National Lab., Tenn.). Jul 1972. Contract W-7405-eng-26. 26p. (ENDF-170). Dep. NTIS.

The experimental and calculational details for a CSEWG integral data testing shielding experiment are presented. The experiment was designed to test a given set of neutron total cross sections for a type-310 stainless steel in the range 1.2 to 11 MeV. A FORTRAN package is available to perform much of the manipulation described. (M.H.R.)

PHYSICS (SOLID-STATE)

Radiation Effects

Refer also to abstracts: 45664, 45668, 45671, 46076, 46550, and 47214.

47225 (AWRE-O-31/72) SOME MEASUREMENTS OF THE ELECTRICAL CONDUCTIVITY INDUCED IN POLYMERS BY PULSED X-RAY IRRADIATION. Barry, J. F.; Culliford, E. R. (Atomic Weapons Research Establishment, Aldermaston (England)). May 1972. 22p. Dep. NTIS (U. S. Sales Only). UK 50 pence.

The electrical conductivity induced by pulsed x-ray irradiation was measured for the materials Mylar, polythene, and PTFE. Dose rates in the range 10^7 to 10^{11} rad/sec at x-ray energies up to 4.5 MeV were used. For a given material, the results exhibit considerable scatter from sample to sample. This is attributed to minor variations in the electrode structure and in the composition of the materials, their effects being enhanced at the low conductivity levels involved. The results indicate that the conductivity varies linearly with dose rate, no strong evidence being found for saturation effects up to the maximum dose rate of 10^{11} rad/sec. (auth)

47226 RADIATION-INDUCED CENTERS OF PARAMAGNETIC AND OPTICAL ABSORPTION IN GLASSES OF THE SYSTEMS $SrO-SiO_2$ AND $BaO-SiO_2$. Tyul'kin, V. A. Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 1, 131-4(Jan 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 1, 152-5(Jan 1972).

The EPR and electron absorption spectra of gamma-irradiated glasses from the systems $SrO-SiO_2$ and $BaO-SiO_2$ were studied. The data are compared with the results of previous investigations of glasses of the systems $MgO-SiO_2$ and $CaO-SiO_2$. Regardless of the type of MO oxide, identical radiation centers arose in glasses in the system in question; however, the oxide concentration range in which a given variety of center predominates depends on the type of MO. The influence of concentration and M^{2+} cation type on the EPR line half-widths is discussed. Broadening of the lines was mainly due to dipole-dipole interaction between holes (or electrons) and the magnetic moment of the nucleus of a M^{2+} ion in the first coordination sphere. (auth)

47227 PROPERTIES OF RUBY LASER RADIATION UNDER THE ACTION OF ^{60}Co GAMMA RADIATION. Arifov, U. A.; Bedilov, M. R.; Khaidarov, K.; Egamov, U. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk SSSR; 203: No. 1, 68-70(1 Mar 1972). (In Russian).

It is known that small doses ($<10^4$ rad) for γ radiation increases the efficiency of a ruby laser by 300%. A study was made of the effect of ^{60}Co γ radiation in doses of 0 to 10^4 rad on the properties of the stimulated radiation of a ruby laser, utilizing photoelectric, calorimetric, spectral, and photographic methods. It was found that doses 10^3 rad and greater decreased the output of the laser, altered the absorption spectrum of the ruby itself, and changed the distribution of radiation with respect to the ruby cross section and the duration of pulse. (K.S.W.)

47228 ION CHANNELING. Dearnaley, Geoffrey (United Kingdom Atomic Energy Authority Research Group, Harwell, Eng.). Sciences (Paris); No. 76, 39-47(Jan 1972). (In French).

Developments that have occurred since the experimental discovery of the channeling phenomenon are reviewed. The phenomenon is briefly defined and its consequences are examined (ion implantation and decreases in the yield of nuclear reactions). Possible applications are envisaged. (France)

47229 ELECTRON IRRADIATION EFFECTS IN ALUMINUM SINGLE CRYSTALS. Kirkland, Leland Rose Jr. Clemson, S. C.; Clemson Univ. (1971). 122p. University Microfilms Order No. 72-20,781.

Thesis.

The work on Al single crystals was undertaken to determine the relationship between the I_B recovery and the ⟨100⟩ directions. Information about this relationship was obtained by observing how the I_B recovery depends upon irradiation energy, sample thickness, and sample crystallographic direction parallel to the irradiation beam. Experimentally, the defects were detected by changes in the electrical resistivity of the samples. The dependence of the residual electrical resistivity upon sample size is determined from preirradiation measurements on the samples. Between measurements, the sample thicknesses were reduced by using a chemical polish. The theory of Dingle is adapted to analyze the data. The results give good agreement with the theory of the size effect and show that the electron mean free path in the present samples is 0.0134 cm. The product of the bulk resistivity and this mean free path is 7.6×10^{-12} Ω cm^2. Damage rate studies give results that are in agreement with previous work. The damage rate is not sensitive to the crystallographic direction parallel to the irradiation beam for recoil energies below 25 eV. At higher recoil energies, the damage rate does have a slight crystallographic dependence. The analysis of the I_B recovery confirms the assignment of the I_B substage to the recovery of close-pair defects. Comparison of experiment to first-order recovery theory shows that I_B defects have an activation energy of 0.042 eV. Annealing data show that the magnitude of the I_B recovery is sensitive to irradiation energy, sample thickness, and sample crystallographic direction parallel to the irradiation beam. A theory is derived for the creation of the I_B defects based on the fact that these defects are caused by atoms recoiling with low energy along ⟨100⟩ directions. An essential assumption of this theory is that the number of I_B defects is proportional to the electron fluence capable of causing low energy atomic recoils along a ⟨100⟩ direction. Comparison of theory to experimental data indicates that I_B defects are created when atoms are displaced with energies in the interval from 16 to 21 eV and recoil within 16° of a ⟨100⟩ direction. (TSS)
(Diss. Abstr. Int., B)

47230 RECOMBINATION DOMAIN INSTABILITY IN HIGH-ENERGY ELECTRON-IRRADIATED GERMANIUM. Wada, Takao (Mie Univ., Tu, Japan); Fukuoka, Yutaka; Arizumi, Tetsuya. Jap. J. Appl. Phys.; 11: No. 7, 1009-15(Jul 1972).

When a bar of n-type germanium (1 to 2 Ω-cm) is irradiated with a total flux of about 10^{15} to 10^{16} electrons/cm^2 at 8.5 MeV, domains of high electric field in the irradiated crystal appear at a high field above 350 V/cm and 77 K. At sufficiently high electric fields, current-voltage characteristics, estimated by observing an instantaneous current density and a time constant associated with the trapping of hot electrons at defect centers, have a voltage-controlled differential negative resistance region; thus, the high-field domain is formed by the buildup of the space-charge boundaries. The velocity of the moving domain ranged from 10^5 cm/sec to 2×10^6 cm/sec, depending upon the light intensity. (8 figures, 1 table) (auth)

47231 COMPARISON OF LATTICE PARAMETER AND RESISTIVITY CHANGE IN ELECTRON-IRRADIATED COPPER. Dworschak, F.; Wagner, H.; Wombacher, P. (Kernforschungsanlage, Juelich, Ger.). Phys. Status Solidi (b); 52: No. 1, 103-9(1 Jul 1972).

Lattice parameter and residual resistivity measurements were performed simultaneously on high-purity copper samples irradiated with 2.6-MeV electrons at 6°K up to defect concentrations of about 0.1%. Lattice-parameter changes could be measured with a resolution of $\Delta a/a = 5 \times 10^{-6}$. In six irradiations, the ratio $\eta = (\Delta a/a)/\Delta\rho$ was determined as a function of defect concentration and thermal recovery. During defect production, the ratio η amounts to $(1.75 \pm 0.10) \times 10^3$ $(\Omega cm)^{-1}$ and is independent of the defect concentration. Furthermore, the ratio η stays constant throughout the recovery stages I, II, and III. (auth)

47232 OPTICAL WAVEGUIDING IN PROTON-IMPLANTED GaAs. Garmire, E. (California Inst. of Tech., Pasadena); Stoll, H.; Yariv, A.; Hunsperger, R. G. Appl. Phys. Lett.; 21: No. 3, 87-8(1 Aug 1972).

Optical waveguides were produced in n-type GaAs by implantation with 300-keV protons. The guiding is shown to be due to the elimination of charge carriers from the implanted region. Annealing of the waveguide leads to very large reductions in the 1.15-μ guided-wave absorption. (auth)

47233 PARAMAGNETIC HOLE CENTERS IN CeO_2. Wagner, G. R.; Murphy, J. (Westinghouse Research Labs., Pittsburgh). Phys. Rev., B; 6: No. 5, 1638-44(1 Sep 1972).

ESR spectra of three hole centers were observed in nominally pure crystals of CeO_2 following uv irradiation at 77°K. Designated V_I, V_{II}, and V_{III}, the centers exhibit orthorhombic symmetry with principal axes (x, y, z) parallel to [$\bar{1}$10], [001], and [110], respectively. The g values are: $g_x(I) = 2.0311$, $g_y(I) = 2.0065$, $g_z(I) = 2.0330$; $g_x(II) = 2.0175$, $g_y(II) = 2.0054$, $g_z(II) = 2.0317$; and $g_x(III) = 2.0268$, $g_y(III) = 2.0050$, $g_z(III) = 2.0415$. The V_{III} center exhibits a hyperfine interaction with a nuclear spin $I = \frac{1}{2}$ for which $A_x = 3.1$, $A_y = 2.3$, and $A_z = 2.7$ in units of 10^{-4} cm^{-1}. The thermal bleaching of the centers was correlated with the thermolumines-

cence of the same crystals measured by Land and Rodine. Models proposed for these centers involve an O_2^- molecular ion near a stabilizing impurity ion. (auth)

47234 CHANNELING OF PROTONS IN THIN $BaTiO_3$ CRYSTALS AT TEMPERATURES ABOVE AND BELOW THE FERROELECTRIC CURIE POINT. Gemmell, D. S.; Mikkelson, R. C. (Argonne National Lab., Ill.). Phys. Rev., B; 6: No. 5, 1613-35 (1 Sep 1972).

The channeling of 3.8-MeV protons in thin (3 to 20-μ-thick) $BaTiO_3$ crystals was studied at 140°C (i.e., in the cubic paraelectric phase) and at room temperature (i.e., in the tetragonal ferroelectrically polarized phase). The influence of channeling on backscattering yields, on characteristic x-ray production, and on the transmitted protons, was determined. For the purpose of fitting the data for the cubic phase, the formulas that Barrett found to fit a large range of data on channeling in monatomic crystals were extended to the polyatomic case. The quality of the fit thus obtained is fair, but not as good as those obtained in monatomic lattices. Data are also presented on dechanneling and on the influence of radiation damage on the channeling properties of $BaTiO_3$. In the polarized tetragonal phase, it is found that the channeling properties are strongly affected by the relative orientations of the crystal planes and the polarization of the crystal. The effect of polarization is attributed to the associated high internal electric fields. (auth)

47235 DISTRIBUTION OF ALKALI IONS IN NICKEL BY IONIC BOMBARDMENT. Kasymov, A. Kh.; Pugacheva, T. S.; Safarov, A. (Tashkent Polytechnic Inst.). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat Nauk; No. 6, 41-6(1971). (In Russian).

The technique of alloying a material by the use of ion bombardment was further investigated by calculations with beams of Li, Na, K, Rb, Cs, and Ba ions having energies of from 1 to 10 keV incident on polycrystalline nickel. A threshold displacement energy of 25 eV was assumed. The extent of penetration of light ions was, in general, greater than that of heavy ions. The coefficient of reflection weakly decreases with increase in the energy of the incident ions, and increases with smaller ion masses. (K.S.W.)

47236 MASS DEPENDENCE OF CRITICAL AMORPHIZING DOSE IN ION IMPLANTATION. Furukawa, Seijiro; Ishiwara, Hiroshi (Tokyo Inst. of Tech.). Jap. J. Appl. Phys.; 11: No. 7, 1062-3(Jul 1972).

Equations are derived for the critical dose to produce an amorphous layer: $\phi_c = 4\langle\Delta R_p\rangle N E_d/\xi E_c$. Calculations were performed for Si targets and compared with the experimental mass dependence for ions from H to Bi. (D.L.C.)

47237 ELECTRICAL PROPERTIES OF n-TYPE Si LAYERS DOPED WITH PROTON BOMBARDMENT INDUCED SHALLOW DONORS. Ohmura, Y.; Zolta, Y.; Kanazawa, M. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Japan). Solid State Commun.; 11: No. 1, 263-6(1 Jul 1972).

Sheet Hall coefficients and resistivities of n-type Si layers doped with shallow donors produced by proton bombardment were measured between 35 and 300°K. The donor ionization energy is (26 ± 1) MeV. The donor concentration profile was determined. (auth)

47238 ANGULAR DEPENDENCE OF THE EROSION RATE AND OF SPECIFIC ENERGY LOSSES OF 5.6 keV NOBLE GAS IONS ON GLASSES. Bach, H. (Jenaer Glaswerk Schott and Gen., Mainz). J. Mass Spectrom. Ion Phys.; 9: No. 3, 247-52 (Aug 1972). (In German).

With an ion-beam apparatus, the angular dependence of the sputtering yields, specific energy losses, and luminescence were measured for glasses and thin oxide layers. According to the results obtained, the angular dependence of the sputtering yield is not always mainly due to the orientation of the impulse vector. It is also influenced by the elastic reflection of a considerable number of those ions that do not contribute to the yield. This number increases for lower angles of incidence if the ratio $\mu = M_2/M_1$ of the effective mass numbers of the glass components M_2 and the ions M_1 is increased. (auth)

47239 FIELD-ION MICROSCOPE STUDY OF ION-IMPLANTATION IN IRIDIUM. I. PHILOSOPHY AND PRELIMINARY CONSIDERATIONS. O'Connor, G. P.; Ralph, B. (Cambridge Univ., Eng.). Phil. Mag.; 26: No. 1, 113-28(Jul 1972).

The field-ion microscope was used to investigate some of the processes occurring during ion implantation, in particular, the fate of the implanted species. Attention is therefore paid to point defect contrast in field-ion images to establish the validity of counting such defects. The importance of bright spots is emphasized since they may represent the only type of contrast which could lead to unambiguous detection of isolated implanted atoms. Since self-interstitial atoms released from traps by the imaging process contribute to the bright spot concentration, consideration is given to the imaging mechanism and to means of distinguishing between bright spots caused by different defects. It is shown that, in the case of oxygen implants, such a distinction is possible, and further, that the implanted species is trapped, possibly as part of a "complex." Control experiments to ensure that real effects are observed, and errors in defect counts are briefly mentioned and it is concluded that significant data can be extracted from field-ion micrographs provided care is taken in selecting a suitable implantation. (auth)

47240 FIELD-ION MICROSCOPE STUDY OF ION-IMPLANTATION IN IRIDIUM. II. RESULTS AND DISCUSSION. O'Connor, G. P.; Ralph, B. (Cambridge Univ., Eng.). Phil. Mag.; 26: No. 1, 129-42(Jul 1972).

The methods of data analysis described in Part I are applied to a determination of the damage and implant profiles for iridium specimens bombarded with keV ions of carbon, oxygen, xenon, silver, and iron. It is shown that bright spot counting is a valid technique and can, in suitable circumstances, lead to a direct derivation of the implant profile. The damage profile in all cases is positioned deeper into the specimen than the implant profile and, since the displacement between them increases with decreasing temperature of irradiation, it is concluded that focused replacement sequences provide the main method for the transport of energy. The effects of recoil implantation of surface contaminant species are observed directly, and it is shown that the concentration of impurity species has an important effect on the annealing behaviour of ion-implanted specimens. (auth)

47241 DIRECT OBSERVATION OF GRAIN BOUNDARY DISLOCATION CLIMB IN ION-IRRADIATED GOLD BICRYSTALS. Komem, Y.; Petroff, P.; Balluffi, R. W. (Cornell Univ., Ithaca, N. Y.). Phil. Mag.; 26: No. 1, 239-52(Jul 1972).

Thin-film gold bicrystals containing (001) low-angle twist boundaries, with twist angles in the range $\theta = 7$ to 14°, and high-angle twist boundaries with $\theta \simeq 37°$, were prepared by welding evaporated films together face-to-face. All the boundaries contained regular orthogonal arrays of intrinsic screw grain boundary dislocations (GBD's) as well as more randomly occurring extrinsic edge GBD's having Burgers vectors essentially perpendicular to the boundary. The specimens were irradiated on one face with 20-keV gold ions producing excess self-interstitial atoms which diffused to the extrinsic GBD's, causing them to climb in the boundary. The extrinsic BGD climb, in turn, caused the boundaries to act as overall interstitial sinks. The climb motion was observed directly by transmission electron microscopy. The intrinsic screw GBD's in the high-angle boundaries (and probably also in the low-angle boundaries) remained unaffected during the process, but possibly they acted as short circuiting pipes which delivered interstitials to the extrinsic GBD's. It is concluded generally that both low- and high-angle boundaries may act as point defect sinks (sources) by means of the climb of GBD's having Burgers vectors with components normal to the boundary plane. This process is actually a form of internal crystal growth (dissolution) with the GBD's acting as "internal crystal ledges." (auth)

47242 ELECTRON STIMULATED DESORPTION OF CARBON MONOXIDE ADSORBED ON NIOBIUM (111). Davis, Paul Richard. Pullman, Wash.; Washington State Univ. (1972). 56p. University Microfilms Order No. 72-18,510.

Thesis.

Electron-stimulated desorption of carbon monoxide adsorbed on the (111) crystal face of niobium at 150°K was found to produce both O^+ and CO^+ ions. The CO^+-producing state was desorbed completely at temperatures above 250°K. At temperatures above 700°K, the O^+ ion current completely disappeared, due to dissociation of the adsorbed molecules. Threshold energies for formation of O^+ and CO^+ ions were measured to be 19.0 ± 0.5 eV and 10.0 ± 0.5 eV respectively. The cross section for CO^+ production by 100-eV electrons was found to be $(9 \pm 2) \times 10^{-20}$ cm^2. (Diss. Abstr. Int., B)

47243 DETERMINATION OF THE SPATIAL DISTRIBUTION OF DEEP CENTERS FROM CAPACITANCE MEASUREMENTS OF PN JUNCTIONS. Zohta, Yasuhito; Ohmura, Yamichi (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Japan). Appl. Phys. Lett.; 21: No. 3, 117-19(1 Aug 1972).

Effects of a spatial distribution of deep centers on the junction capacitance are reported for the first time. It is shown that the spatial distribution of deep centers can be calculated from capacitance-voltage method and the Copeland method, if their energy

level is known or assumed. The theory is examined with the experiment on silicon p^+n junctions irradiated with 300-kV protons. The analysis yields a value 0.40 eV below conduction band for the energy level of radiation-induced defects, as well as a distribution of the defects with depth. (auth)

47244 INTERACTION OF A RUBY WITH IONIZING RADIATION. Ermolaev, E. A.; Shelekhin, Yu. L.; Votinov, M. P. Tr. Leningrad. Politekh. Inst.; No. 325, 78-80(1971). (In Russian).

A rose ruby (0.05 percent Cr_2O_3 in burden) was irradiated by ^{60}Co γ rays (10^8 R) and thermal neutrons (10^{16} to 10^{17} n/cm^2 at room temperature, and single crystals of corundum (and ruby) were irradiated by x rays (10^4 roentgens) at liquid-nitrogen temperature. The irradiated crystals acquired an orange tint. Two additional absorption bands with centers at 370 and 460 nm appeared in the optical spectrum, the Cr^{3+} content decreased by 11 to 18%, and the nonuniformity of the intracrystalline field increased by 30 to 40%. It was confirmed that the induced coloring is associated with a change in the valence state of the chromium and the formation of color centers in the matrix defects. (JPRS)

47245 VTORICHNO-EMISSIONNYE I STRUKTURNYE SVOISTVA TVERDYKH TEL. (Secondary Emission and Structural Properties of Solid Bodies). Arifov, U. A. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1970). 212p.

This publication contains 36 papers by different authors on the interaction of ion, electron, and positron beams with matter. The phenomena of sputtering, secondary ion and electron emission, and the changes in the physico-chemical properties of substances are discussed. Adsorption during ion bombardment and the annihilation of positrons in solids are reviewed. (tr-auth)

47246 ACCUMULATION OF F CENTERS IN NaCl CRYSTALS AS A FUNCTION OF THE PROTON-BEAM INTENSITY. Vaisburd, D. I.; Alekseev, P. D. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 27-31(1971). (In Russian).

The dependence of the yield of radiation defects on the radiation intensity is discussed. The form of these relations is determined by the ratio between the relaxation time of processes in particle tracks and the overlapping time of tracks. The existence of an optimum intensity was demonstrated at which the yield of defects was maximum. In the accumulation of F centers at a slow rate at 295°K, an essential role is played by processes having a relaxation time of the order of 10 seconds. (tr-auth)

Physical Properties

Refer also to abstracts: 45992 and 46023.

47247 (BNWL-1511) HIGH-TEMPERATURE ELECTRICAL CONDUCTIVITY OF CeO_{2-x}. Bates, J. Lambert (Battelle Pacific Northwest Labs., Richland, Wash.). Jun 1972. Contract AT(45-1)-1830. 21p. Dep. NTIS.

The electrical conductivity of CeO_{2-x} was measured from 16 to 1998°C in argon containing a low partial pressure of oxygen. The electrical conductivity of CeO_2 increased during five heating cycles as the O/Ce ratio decreased to a final value of 1.82. The energy for conduction below 1900°C decreased during the heating cycles as the conductivity increased. Three discontinuities in the log σ versus 1/T curves were observed at approximately 1000, 1150, and 1900°C. Above 1900°C, the conductivity decreased sharply with increasing temperature. After heating to 1900°C, no discontinuities were observed in the log σ versus 1/T curve for $CeO_{1.82}$ below 1900°C. (auth)

47248 ELECTRICAL AND THERMAL CONDUCTIVITIES OF RHENIUM, OSMIUM, AND IRIDIUM AND SOME OF THEIR ALLOYS WITH THORIUM AND LANTHANIUM IN A WIDE TEMPERATURE RANGE. Gugnin, A. A.; L'vov, S. N.; Mal'ko, P. I.; Nemchenko, V. F.; Starodubov, I. P. (Kherson Pedagogical Inst., USSR). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 1, 51-5(Jan 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 1, 65-70(Jan 1972).

Studies were made on the effects of temperature on the electric conductivity, ρ, and thermal conductivity, λ, of Re–Th, Os–Th, and Ir–La alloys produced from powders of their starting components. Results are given for measurements of ρ and λ for pressed and fused Re, Os, and Ir specimens and the above alloys in the ranges 100 to 1700°C and 100 to 1200°C, respectively. The electric conductivity in the temperature range investigated was much higher than that of their base metals. The thermal conductivity in the temperature range investigated was much less than that of the pure base metals. This, together with the increase in the electric conductivity of the alloys, was evidence that the Wiedemann–Franz law is qualitatively satisifed. With rise in temperature, the thermal conductivity of the alloys fell, and, at high temperatures, quite distinctly tended to a constant value. On this basis, it was concluded that the thermal conductivity of these alloys at such temperatures is mainly electronic in character. (P.C.H.)

47249 ELECTRICAL CONDUCTIVITY, THERMO-EMF, AND THERMIONIC EMISSION OF BaO AND SrO CRYSTALS. Kovalev, N. N.; Sorokin, O. V. (Inst. of Semiconductors, Leningrad). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 1, 94-9(Jan 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 1, 111-16(Jan 1972).

The thermo-emf was measured for single crystals of BaO and SrO in order to calculate the position of the Fermi level relative to the bottom of the conductivity zone. From measurements of the thermoemission current, the thermodynamic work function was obtained. Comparison of the electron affinity with its value for the surface, obtained from photoelectric measurements, showed that in vacuum the bending of the zones at the surface must be small in comparison with φ and χ. Estimation of the positions of the donor levels in the forbidden zone led to the conclusion that, in all probability, these are F centers. The electron mobilities in the conductivity zones of BaO and SrO were estimated. Comparison with theoretical data showed that they are mainly determined by interaction with polar optical vibrations. It was found that when $E \geq 10^4$ V/cm, the thermionic emission follows the normal Schottky law. (auth)

47250 CARBIDE RESISTORS. Grebenkina, V. G. (Inst. of Problems in Materials Science, Kiev). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 1, 161-2(Jan 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 1, 181-2(Jan 1972).

The temperature dependence of the electric conductivity of niobium carbides was investigated between room temperature and 1000°C. In the region of homogeneity, the electric conductivity of niobium monocarbide increased with the defect density of the carbon sublattice. This was due to an increase in the concentration of additional scattering centers in the form of vacancies in the carbon sublattice. The temperature coefficient of the resistance (TCR), on the other hand, decreased as the lower limit of the region of homogeneity was approached. Test results for resistors with $NbC_{0.74}$ as current-carrying phase revealed that resistors prepared from this substance have the following principal characteristics: rated value, 1Ω; TCR, -5×10^{-4} deg^{-1}; moisture retention 1%. (P.C.H.)

47251 NEUTRON SCATTERING. Jacrot, Bernard (Institut Max von Laue–Paul Langevin, Grenoble, France). Recherche (Paris); 3: No. 22, 325-33(Apr 1972). (In French).

The usefulness of thermal neutrons from high-flux nuclear reactors for studying the condensed structure of matter (positions and motion of atoms in matter) is emphasized. Neutron- and x-ray-diffraction techniques are compared (magnetic structures and crystalline structures). The use of inelastic neutron scattering in the study of the dynamics of condensed matter is presented. (France)

47252 ELECTRON SPIN RESONANCE IN SINGLE CRYSTAL YTTRIA STABILIZED ZIRCONIA. Thorp, J. S.; Aypar, A.; Ross, J. S. (Durham Univ., Eng.). J. Mater. Sci.; 7: No. 7, 729-34 (Jul 1972).

Electron spin resonance was observed at 35 GHz in 8 and 12 mol % yttria-stabilized zirconia single crystals before and after blackening by current passage. Measurements were made between 293 and 77°K. In both as-grown and blackened crystals, the spectra showed anisotropic lines (type A) characterized by $g_{||} = 2.003 \pm 0.002$ and $g_{\perp} = 1.880 \pm 0.002$ with respect to a [111] symmetry axis and a broader, slightly anisotropic line (type B) centered near g = 1.993. In current-blackened crystals, a weak isotropic line (type C) was also found near g = 1.986. The type-A lines are attributed to a charged complex formed by an electron trapped at an oxygen vacancy and associated with an yttrium ion. Tentative models are suggested to explain the type-B and type-C lines. (auth)

47253 ANISOTROPY IN THE PARAMAGNETIC SUSCEPTIBILITY OF SOME RARE EARTH ELEMENTS. Aleonard, Roland (Centre National de la Recherche Scientifique, Grenoble, France). Compt. Rend., Ser. B; 274: No. 16, 967-9(17 Apr 1972). (In French).

The changes in the paramagnetic susceptibilities of Gd, Tb, Dy,

Ho, and Er monocrystals as a function of temperature were measured (5 to 750°C) for various orientations of the field with respect to the crystallographic axes. (France)

47254 ELECTRON DENSITY IN TUNGSTEN CRYSTAL ACCORDING TO NEUTRON–ELECTRON INTERACTION DATA. Aleksandrov, Yu. A.; Ozerov, R. P.; Ranev, N. V. (Inst. of Physics and Chemical Research, Moscow). JETP Lett. (USSR) (Engl. Transl.); 15: No. 7, 280-2(5 Apr 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 7, 398-400(5 Apr 1972).

Measurements of the electron density distribution on the (001) plane of W were made using neutron diffraction and x-ray scattering. The two results are identical. (D.L.C.)

47255 ENERGY SPECTRUM AND CRYSTALLINE STRUCTURE OF WURTZITE-LIKE MODIFICATION OF BORON NITRIDE. Frantsevich, I. N.; Zhurakovskii, E. A.; Kurdyumov, A. V.; Vasilenko, N. N. (Inst. of Problems of Materials, Kiev). Dokl. Akad. Nauk SSSR; 203: No. 1, 87-90(1 Mar 1972). (In Russian).

The four known crystal modifications of BN are BN_{hex}, BN_{rhomb}, BN_{cube}, and BN_{hex-w}, where the last is a hexagonal structure resembling wurtzite. A spectral and x-ray-structure study was made of BN_{hex-w} prepared by pulsed compression of BN_{hex}. B–N bond lengths, interlayer distances, and emission K_α bands in the various BN modifications were compared. (K.S.W.)

47256 MAGNETIC SURFACE STATES IN ZINC AND CADMIUM. Rahn, John Phillip. Seattle; Univ. of Washington (1972). 101p. University Microfilms Order No. 72-20,886.

Thesis.

Magnetically induced surface electron state resonances as a function of sample orientation were studied for the first time in high-purity single crystals of zinc and cadmium. The transition magnetic fields are recorded for all sample orientations in three principal crystallographic planes. The experimentally observed magnetic fields of the surface resistance derivative maxima agree with the Nee–Prange theory. The angular behavior of these magnetic fields is compared to those predicted by a semi-empirical OPW pseudopotential band model. Conversely, an iteration scheme is used to obtain the point Fermi velocities from the measured data points for the third-band electron lens. The agreement between the predicted and observed magnetic field is excellent for the lens. From the point velocities, it is concluded that the electron–phonon renormalization of the one-electron energy bands is not constant even on the spherical portion of the lens. (Diss. Abstr. Int., B)

47257 TEMPERATURE DEPENDENCE OF THE WORK FUNCTION OF THE Ba–W_{110} SYSTEM. Shul'man, A. R.; Kirsanova, T. S.; Belova, V. M. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 16: No. 10, 1792-3(Oct 1971).

Translated from Radiotekh. Elektron.; 16: No. 10, 2003-4 Oct 1971).

The work function of W(110) covered with Ba (coverage varied from $\theta = 0.5$ to 2) was measured at 600 to 900°K. The coefficient $\Delta\phi/\Delta T$ has different values, being $\sim 4 \times 10^{-4}$ eV/deg at 580 to 700°K and 1.2×10^{-3} eV/deg at 700 to 900°K. The results are compared with these for the BaO–W system. Dips are visible in the $\phi(T)$ curves, especially for $\theta = 0.8$. (D.D.C.)

47258 dc ANISOTROPIC MAGNETIZATION AT 20.4 K AND THE IDEAL CRYSTAL-FIELD-ONLY BEHAVIOR OF TmSb. Foner, S. (Massachusetts Inst. of Tech., Cambridge); Cooper, Bernard R.; Vogt, Oscar. Phys. Rev., B; 6: No. 5, 2040-4(1 Sep 1972).

The anisotropic magnetization of TmSb at 20.4°K was measured in applied dc fields up to 144 kOe. The experimental results are in excellent agreement with isothermal crystal-field-only theory for parameters deduced from earlier pulsed-field experiments at 1.5°K. This resolves an ambiguity posed by earlier pulsed-field magnetization experiments at 20.4°K, the results of which fell between the adiabatic and isothermal crystal-field-only theoretical curves. High-resolution dc measurements of the magnetization at 1.5°K were also made up to 52 kOe and are in good agreement with the earlier pulsed-field data. (auth)

47259 PARAMAGNETIC SUSCEPTIBILITIES OF METALLIC SAMARIUM COMPOUNDS. Stewart, A. M. (Univ., Genova. Imperial Coll. of Science and Tech., London). Phys. Rev., B; 6: No. 5, 1985-98(1 Sep 1972).

It is shown that the influence of conduction-electron polarization effects upon the susceptibilities of metals containing the tripositive samarium ion is very much greater than upon metals containing normal rare earths. A theory of the susceptibility of metallic samarium materials is developed that takes account of these polarization effects and of interionic Heisenberg exchange couplings, the admixture of the $J = 7/2$ state into the $J = 5/2$ ground state, which is assumed to be the only one to be thermally populated, but which, however, does not take account of crystal-field splittings. The susceptibility is found to be of the unexpectedly simple form $\chi(T) = \chi_0 + D/(T - \theta)$, in which the only dependence on temperature T is that explicitly shown. This expression is found to fit the published data for the susceptibility of dhcp samarium to an accuracy of 1% in the temperature region 110 to 230°K, and the parameters extracted from the fit are found to be in excellent agreement with those obtained for the other light rare-earth metals. An expression is also derived for the susceptibilities of metals containing normal rare earths, which takes account of both conduction-electron polarization and crystal field effects. (auth)

47260 SINGLE-ELECTRON ENERGIES, MANY-ELECTRON EFFECTS, AND THE RENORMALIZED-ATOM SCHEME AS APPLIED TO RARE-EARTH METALS. Herbst, J. F. (Cornell Univ., Ithaca, N. Y.); Lowy, D. N.; Watson, R. E. Phys. Rev., B; 6: No. 5, 1913-24(1 Sep 1972).

A systematic investigation of certain electronic properties of the rare-earth metals is reported. Calculations are performed within the framework of the renormalized-atom method in which Hartree–Fock free-atom solutions, with electronic configurations appropriate to the metal, are initially computed; the wave functions are then renormalized to the Wigner–Seitz sphere and used to construct l-dependent Hartree–Fock–Wigner–Seitz crystal potentials. The following results are obtained: (i) Recent spectral information together with the free-atom solutions permits one to estimate the change in neutral-atom correlation energy associated with changing the 4f electron count; contrary to expectation, it is found that correlation effects are more significant in a configuration with one fewer 4f and one more 5d electron. (ii) Band extrema and Fermi levels are placed. (iii) The positions of occupied and unoccupied 4f levels are estimated in both a one-electron approach and a multielectron method taking screening and relaxation effects into account in a definite way. The one-electron approximation for the 4f levels fails badly in reproducing the results of recent photoemission experiments, while the multielectron calculations are in surprisingly good accord with experiment. The effective Coulomb-interaction energy between two 4f electrons at the same site, the familiar U, is reduced from the single-particle value of approximately 27 eV to about 7 eV with the inclusion of multielectron effects. (iv) Hartree–Fock values for the 4s- and 5s-shell exchange splittings are compared with soft-x-ray photoemission studies of the rare-earth fluorides and oxides; the calculated 4s splittings are roughly twice as large as experiment while, unexpectedly, the 5s results are in almost precise agreement. (auth)

47261 MAGNETIC PHASE DIAGRAM OF THE UAs–US SYSTEM. Lander, G. H.; Mueller, M. H.; Reddy, J. F. (Argonne National Lab., Ill.). Phys. Rev., B; 6: No. 5, 1880-8(1 Sep 1972).

The magnetic phase diagram of the $UAs_{1-x}S_x$ system ($0 \le x \le 1$) was investigated by neutron diffraction with powder samples. The solid solutions are face-centered cubic (NaCl crystal structure), and the anion atoms are distributed randomly over the anion sublattice. For x = 0 (UAs), the type-I antiferromagnetic ordering ($T_N = 127$°K), consisting of ferromagnetic sheets stacked + – + –, changes at $0.5T_N$ to the type-IA ordering, in which the sheets are stacked + + – –. This transition is accompanied by an abrupt increase in the magnetic moment from 1.9 to 2.2 μ_B per uranium atom. As x increases from zero, the stability of the type-IA structure increases until for x = 0.20 this phase is present at all temperatures below T_N. For x between 0.25 and 0.34, the magnetic moments are not arranged in a simple commensurate structure, but their modulation from layer to layer follows a sinusoidal form. Near T_N, a single harmonic is present: The repeat distance in real space varies from ~2.8 unit cells at x = 0.25 to ~4.2 unit cells at x = 0.34. A third harmonic, implying some squaring of the sine wave, appears at about $0.5T_N$. The periodicity is a function of concentration (x) only and does not vary with temperature for a given sample. Although at the ends of this intermediate range the stable phases at low temperature tend to be either type IA (low x) or ferromagnetic (high x), the longitudinal-wave structure is stable to at least 2.2°K over a narrow composition range. (auth)

47262 DETERMINATION OF THE ELECTRON–PHONON ENHANCEMENT FACTOR FROM SPECIFIC-HEAT DATA. Knapp, G. S. (Argonne National Lab., Ill.); Jones, R. W. Phys. Rev., B; 6: No. 5, 1761-7(1 Sep 1972).

The electron–phonon enhancement factor is determined for scandium, yttrium, vanadium, platinum, and palladium solely from specific-heat data. The key to the method is that at high temperatures the electron–phonon enhancement factor is zero. Therefore, if the electronic specific-heat coefficient at high tem-

peratures is calculated and compared with the low-temperature value, both the band-structure density of states and the electron–phonon enhancement factor can be determined. (auth)

47263 STUDY OF HYDROGEN IN VANADIUM. Wanagel, John. Ithaca, N. Y.; Cornell Univ. (1971). 70p. University Microfilms Order No. 72-15,421.

Thesis.

The manner in which the hydride precipitate manifests itself on a polished (100) surface of a single crystal was examined by optical methods. Two different surface features were associated with the formation of a vanadium hydride precipitate. Orientation relationships between co-existing phases were determined using x-ray and electron-microscopy techniques. The axes of the β(bct) hydride phase were shown to be slightly tilted away from the cube axes of the α(bcc) phase. The relationship between the β(bct) phase and the γ(fcc) phase was shown to be such that (100) β|| (110)γ and [001]β|| [001]γ. In the single-phase β(bct) region, frequent examples of twinning were observed on (101) planes. Electron-microscope specimens of vanadium, thinned by techniques known to add hydrogen, showed evidence for ordering in β-vanadium hydride. Extra half-order reflections were observed and concluded to be due to scattering from hydrogen. The transformation between the ordered and disordered phases occurs reversibly at a specific temperature in the range 160 to 190°C depending on the specimen. The reciprocal lattice as determined by electron diffraction was shown to be in the monoclinic Laue group. Indirect evidence places the composition of the ordered phase in the vicinity of V_2H. The possible monoclinic structures consistent with the reciprocal lattice in all cases place the hydrogens in tetrahedral sites on alternate $(101)_{bct}$ planes. Application of tensile stress at 200°K along the [100] direction of a single crystal of vanadium containing about 1.2 at. % hydrogen caused the disappearance of hydride plates and the creation of a large number of slip lines. Deformation twinning was suppressed by the precipitate and fracture was by brittle cleavage on a (100) plane. (Diss. Abstr. Int., B)

47264 LOW-TEMPERATURE ELECTRON–PHONON UMKLAPP SCATTERING IN SIMPLE METALS. Ekin, John W. Ithaca, N. Y.; Cornell Univ. (1971). 121p. University Microfilms Order No. 72-18,552.

Thesis.

The first conclusive evidence for the long postulated low-temperature disappearance of the electron–phonon umklapp scattering contribution to the electrical resistivity of potassium is reported. Accurate low temperatures (1 to 25°K) resistivity data, obtained from potassium samples having residual resistance ratios [RRR = $\rho(20°C)/\rho(0°K)$] in the range from 100 to 8000, are interpreted in terms of a detailed theoretical analysis of umklapp scattering effects. Deviations from Matthiessen's rule, while present, are comparatively small and do not alter appreciably the temperature dependence of the resistivity for even the least pure sample (RRR = 136). In addition, a theoretical analysis of umklapp effects in potassium is performed for the ultrasonic attenuation (in the local limit) and the thermal resistivity. Using various model pseudopotentials and a realistic phonon spectrum, both these quantities are evaluated at temperatures from 1 to 20°K. The rapid decrease of the umklapp component at very low temperatures is emphasized in each case. Accurate (±0.01%)relative accuracy) low-temperature (1 to 100°K) data on the purity and temperature dependence of the electrical resistivity of the simple polyvalent metals, aluminum and cadmium, are also presented and interpreted in terms of electron–phonon umklapp interaction. In contrast to potassium, the resistivity of aluminum exhibits relatively large deviations from Matthiessen's rule and it is suggested that anisotropic umklapp relaxation of the electron distribution may be playing an important role in determining the magnitude of such deviations. (Diss. Abstr. Int., B)

47265 ION–ION EMISSION: A NEW TOOL FOR MASS-SPECTROMETRIC INVESTIGATIONS OF PROCESSES ON THE SURFACE AND IN THE BULK OF SOLIDS. Fogel, Ya. M. (Gorky State Univ., Kharkov). J. Mass Spectrom. Ion Phys.; 9: No. 2, 109-25(Jul 1972).

A brief account of the properties of the ion–ion emission phenomenon is given. The possibilities of applying this phenomenon to the study of processes on the surface and in the bulk of solids are discussed. The foundations of the new method are considered. (auth)

47266 MAGNETIC SUSCEPTIBILITY OF CUBIC NIOBIUM AND TANTALUM CARBIDES IN THE LOW TEMPERATURE RANGE. Borukhovich, A. S.; Dubrovskaya, L. B.; Matveenko, I. I.; Gel'd, P. V. (Inst. of Chemistry, Sverdlovsk, USSR). Tr. Inst. Khim., Akad. Nauk SSSR, Ural. Filial; No. 20, 71-3(Sep 1970). (In Russian).

The magnetic susceptibility of the cubic carbides of Nb and Ta was measured in their regions of homogeneity at low temperatures. The Curie–Weiss function χ for the composition $NbC_{0.80}$ was detected below 30°K. The results were considered in terms of the available concept of the electron structure of these compounds. (tr-auth)

47267 DYNAMICAL THEORY FOR THE CONTRAST OF PERFECT AND IMPERFECT CRYSTALS IN THE SCANNING ELECTRON MICROSCOPE USING BACKSCATTERED ELECTRONS. Spencer, J. P.; Humphreys, C. J.; Hirsch, P. B. (Oxford Univ.). Phil. Mag.; 26: No. 1, 193-213(Jul 1972).

A many-beam dynamical theory, which approximately takes into account multiple inelastic scattering, is formulated and used to calculate the intensity of electrons backscattered from perfect and imperfect crystals. The contrast of channeling pattern lines is discussed and the occurrence of "missing" lines explained. The backscattered intensity due to an inclined stacking fault is calculated. The image consists of damped fringes of periodicity ξ_g; the nature of the first fringe depends on the sign of $g \cdot R$ and no contrast occurs for integral values of $g \cdot R$. Similar calculations were made for dislocations. Reversing the sign of $g \cdot b$ reverses the image contrast for dislocations near the surface, and the usual TEM invisibility criteria hold, namely invisibility for $g \cdot b = g \cdot b_{\Delta}u = 0$. The experimental conditions necessary for the imaging of defects are discussed. Imaging defects in solid specimens should be possible using cold field-emission electron sources. (auth)

47268 STUDY OF DOPPLER-BROADENED ANNIHILATION RADIATION IN METALS WITH A Ge(Li) DETECTOR. Alfano, F.; Reynolds, T.; Ramaswamy, M. K. (Fordham Univ., Bronx, N. Y.). Nuovo Cim.; 10B: No. 1, 334-8(11 Jul 1972).

Doppler-broadened positron annihilation radiation spectra were investigated in twelve metals. A plot of αX^2 vs. E_F for these metals, when grouped according to the periodic table, results in straight lines. (α is the effective-electron–mass ratio m^*/m_0, X is a measure of the observed broadening, and E_F is the Fermi energy.) This feature is consistent with a simple theoretical model. In addition, it suggests a possible method for determining the electron effective mass in other metals. This was utilized to estimate the effective-mass ratio for B as 2.8. (auth)

47269 SOME CRYSTALLINE FIELD EFFECTS IN METALS. Fulde, Peter; Peschel, Ingo (Institut Max von Laue-Paul Langevin, Garching, Ger.). Advan. Phys.; 21: No. 89, 1-67 (1972).

Different physical effects are discussed which are caused by the crystalline electric field splitting of rare earth ions in metals. Thus, the rare earth ions may be impurities dissolved in a metallic matrix or they may form a regular lattice. In the former case, the cases of a normal conducting and a superconducting matrix are distinguished between. The influence of the crystalline field splitting on the properties of the conduction electrons is calculated. In the case of a normal matrix, anomalous behavior of the thermoelectric power is found due to the impurity levels. If the matrix is superconducting, large deviations result from the theory of Abrikosov and Gorkov (1960) which describes the influence of non-split magnetic impurities on superconductivity. A comparison of the theory with available experiments is presented. For the case that the rare earth ions form a regular lattice, various aspects of the collective excitations in the paramagnetic state are discussed. Special attention is paid to the soft mode problem of exchange-induced ferromagnets. Furthermore, the influence of impurities on the excitation spectrum (localized modes, resonant modes, etc.) and on the magnetic ordering temperature is discussed. (auth)

47270 GADOLINIUM g-SHIFTS AND BAND STRUCTURE. Gomes, A. A.; Guimaraes, A. P.; Iannarella, L. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Notas Fis., Cent. Brasil. Pesqui. Fis.; 18: No. 14, 191-8(1972).

A simple s-, d-band model for the rare earths is used to describe the g shifts in metallic systems containing gadolinium. The temperature dependence of the d-electron susceptibility $\chi^{(d)}$ is suggested to explain the apparent discrepancies between the exchange parameters J_{eff} measured using different techniques (EPR, bulk magnetization measurements, hf fields). A numerical calculation shows that a model band with a narrow (~0.1 eV wide) peak near the Fermi level could account for the required variation of $\chi^{(d)}$ in gadolinium metal. (auth)

47271 REMARKS ON Gd g-SHIFTS. Gomes, A. A.; Guimaraes, A. P.; Iannarella, L. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Notas Fis., Cent. Brasil. Pesqui. Fis.; 18: No. 15, 201-7(1972).

The s–d hybridization is given a simple formulation in order to discuss its relevance to the Gd g shifts; it is apparent that the

effective exchange parameters J_{eff} can be negative even with negligible interband mixing. A possible explanation for the signs of the g shift and band magnetization in Gd metal is also suggested. (auth)

47272 MAGNETIC PROPERTIES OF SOME ACTINIDE HALIDE COMPOUNDS. Hendricks, Melvin Elton. Columbia, S. C.; Univ. of South Carolina (1971). 195p. University Microfilms Order No. 72-12,007.

Thesis.

Magnetic susceptibility measurements on 13 actinide compounds were made with a vibrating-sample magnetometer, most in the temperature range 2.5 to 70°K at 10,000 Oe. These compounds, classed according to site symmetry of the actinide ion, are: (1) octahedral: Cs_2NaMCl_6 where M is a trivalent actinide, U, Np, Pu, Am, Cm, Bk, the latter two doped into $Cs_2NaLuCl_6$; (2) C_{3h}: UCl_3, $NpCl_3$, $PuCl_3$; (3) D_{2d}: $PaCl_4$, UCl_4; (4) low-symmetry: PuF_4, UBr_4. Theoretical calculations, including intermediate coupling and limited J-mixing, were performed for several cases for comparison with experimental magnetic properties. Results for the octahedral compounds include determination of ground levels, observation of small distortion effects, and measurements of limits on crystal-field parameters. In the Cs_2NaMCl_6 matrix, the following ground levels were determined: U^{3+}, Γ_5; Np^{3+}, Γ_5; Pu^{3+}, Γ_5; Am^{3+}, Γ_1; Bk^{3+}, Γ_1. The U, Np, and Pu compounds, at the lowest temperatures, gave deviations from Curie–Weiss behavior that are attributed to small distortions from octahedral symmetry. Crystal-field calculations, including J-mixing with the first-excited state, were made for U^{3+} and Np^{3+} for ratios of the octahedral crystal-field parameters, B_6^4/B_6^4, between 0 and +1, varying B_6^4 from 0 to 20,000 cm^{-1}. Assuming an approximately constant B_6^4/B_6^4 ratio in the Cs_2NaMCl_6 series, the limits $+0.07 \leq (B_6^4/B_6^4) \leq +0.77$ were established from analysis of U^{3+} and Np^{3+} data. $Cs_2NaAmCl_6$ below 70°K exhibits temperature-independent paramagnetism, in good agreement with the theoretical value. Bk^{3+} in $Cs_2NaLuCl_6$ also gives temperature-independent paramagnetism. In the C_{3h} trichloride series, several types of magnetic phenomena were observed. Antiferromagnetic ordering was found for UCl_3, $T_N = 22 \pm 1$°K, and for $PuCl_3$, $T_N = 4.5 \pm 1$°K. $NpCl_3$ exhibited temperature-independent paramagnetism below 50°K. Each of the C_{3h} compounds displays Curie–Weiss behavior at relatively low temperatures, with measured moments in close agreement with the free-ion values. Using previously reported wave functions and energy levels for $PuCl_3$, calculated and experimental susceptibilities were in excellent agreement from 10 to 500°K. The D_{2d} compound $PaCl_4$ was found to have a ferromagnetic transition, with $T_C = 182 \pm 2$°K, an unusually high transition temperature for a ferromagnetic insulator. Below 182°K, the magnetization was unsaturated at fields up to 12,000 Oe; hysteresis was not observed above 3.29°K. In the paramagnetic region, $PaCl_4$ obeys the Curie–Weiss law from 182 to 219°K; crystal-field calculations for this region indicate that J-mixing is significant. The D_{2d} compound UCl_4 has a magnetic moment with complex behavior below 190°K, with temperature-independent paramagnetism below 35°K; the susceptibility in this region was reproduced by a simple theoretical model. The magnetic behavior of both PuF_4 and UBr_4 is consistent with low-symmetry crystal fields. PuF_4 showed temperature-independent paramagnetism below 70°K, indicating a fairly large crystal field. UBr_4 was paramagnetic at the lowest temperatures measured, consistent with a small C_{2v} crystal field. Freshly prepared PuF_4 below 15°K gave an anomalously large, temperature-dependent diamagnetism, which disappeared upon aging. (Diss. Abstr. Int., B)

47273 MAGNETIC COMPENSATION IN IRON–GADOLINIUM AND IRON–TERBIUM FILMS. Buravikhin, V. A.; Bochkarev, V. F.; Egorov, V. A.; (and others) (Irkutsk Pedagogical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 88-92(1971). (In Russian).

Physical properties and phase composition of Fe–Gd and Fe–Tb films possessing magnetic compensation were investigated. The effect of phase compensation on galvanomagnetic and magnetic properties was studied. Experiments were conducted for the purpose of elucidating the nature of magnetic compensation which was observed during the initial annealing. Experimental and calculated data were obtained on the phase composition of films after annealing, involving the compounds $GdFe_5$, Gd, Gd_2Fe_7, and Gd_2Fe_{17}. (tr-auth)

Moessbauer Effects and NMR

Refer also to abstract: 46911.

47274 OPTIMUM ABSORBER THICKNESS FOR SINGLE LINE MOESSBAUER EFFECT IN THE PRESENCE OF STRONG NON-RESONANT ABSORPTION. Pelzl, J. (CEN, Grenoble, France). Nucl. Instrum. Methods; 102: No. 2, 349-51(1972).

Estimates of the optimum absorber thickness for a single-line Mössbauer effect measurement are derived. Numerical results for different magnitudes of the background noise are presented. (auth)

47275 ANALYSIS OF FIVE LINE HYPERFINE SPLIT MOESSBAUER ABSORBER SPECTRA. Hershkowitz, N.; Ruth, R. D.; Wender, S. A.; Carpenter, A. B. (Univ. of Iowa, Iowa City). Nucl. Instrum. Methods; 102: No. 2, 205-17(1972).

Sums of Lorentzians are fit to numerical solutions of the transmission integral for five-line hyperfine-split absorber spectra. The general dependences of fit parameters are discussed. Procedures are given to determine actual absorber parameters. (auth)

47276 PRESSURE DEPENDENCE OF MOESSBAUER RECOILLESS FRACTION AND SECOND-ORDER DOPPLER SHIFT. Srivastava, B. N.; Tyagi, R. N. (Government Coll., Naini Tal, India). Indian J. Pure Appl. Phys.; 10: No. 2, 89-92(Feb 1972).

The effect of pressure on the recoilless fraction f for ^{57}Fe (14.4 keV) gamma transition in some host lattices was studied theoretically through the variation of rigidity and density with pressure in low- and high-temperature ranges. The calculated values of f agree closely with the available experimental values. The pressure dependence of second-order Doppler shift for a number of lattices in the pressure range of 0 to 300 kbar was investigated through the variation of rigidity and density. The calculated values of temperature and pressure coefficients for ^{57}Fe compare reasonably well with the values reported by earlier workers. (auth)

47277 PULSE FOURIER TRANSFORM NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY. Netzel, Daniel A. (Northwestern Univ., Evanston, Ill.). Appl. Spectrosc.; 26: No. 4, 430-42(1972).

Recent advances in NMR spectroscopy allow one to study extremely dilute systems or nuclei which occur in low natural abundance and/or have poor sensitivity for NMR detection. This paper describes various pulse and pulse Fourier transform NMR techniques. Included in this introduction are: (1) a brief review of the nuclear relaxation phenomenon, (2) sensitivity enhancement using the pulse technique, (3) pulse instrumentation, and (4) the analytical applications of pulse Fourier transform NMR. 31 references. (auth)

47278 SOME RECENT DEVELOPMENTS IN HIGH RESOLUTION NUCLEAR MAGNETIC RESONANCE. Becker, Edwin D. (National Institutes of Health, Bethesda, Md.). Appl. Spectrosc.; 26: No. 4, 421-30(1972).

Techniques for studying high-resolution nuclear magnetic resonance spectra have been considerably broadened in recent years. The most far reaching development—pulse Fourier transform (FT) methods—is discussed in detail. Applications of FT techniques to measurement of relaxation times and to enhancement of weak signals, especially from natural-abundance ^{13}C, are reviewed. Double resonance methods, particularly the nuclear Overhauser effect, and the use of lanthanide shift reagents are also covered in this "mini-review." 39 references. (auth)

47279 POWDER ENDOR LINE SHAPES: NUCLEAR RELAXATION INDUCED BY MOTION OF NEARBY ELECTRON SPINS. Leniart, Daniel S.; Hyde, James S.; Vedrine, Jacques C. (Varian Associates, Palo Alto, Calif.). J. Phys. Chem.; 76: No. 15, 2079-87(20 Jul 1972)

The line shape and intensity of electron–nuclear double resonance (ENDOR) spectra in powders is determined, in part, by the specific form of the mechanism(s) that produce nuclear spin–lattice relaxation. In all cases investigated, nuclear relaxation is assumed to stem from modulation of the electron–nuclear dipolar (END) interaction. The initial model considered assumes that the unpaired electron is trapped in a cage and undergoes a series of jumps between at least two equally probable sites. The dimensions of the cage are such that any fluctuations in angle are severely restricted, and this jumping motion results only in a modulation of the interparticle distance between the trapped H atom and surrounding nuclei outside the cage. It is shown that the dominant relaxation component of the surrounding nuclei is proportional to $\sin^4 \theta$ and leads to a doubly peaked ENDOR spectrum. The second model assumes that the trapped electron resides in a cage whose walls are at infinite potential, and the system is treated quantum mechanically as a particle in a three-dimensional box. The thermal lattice motions of the cage modulate the dipolar interaction in some random manner to produce a spectral density which differs from that of the jump model by the

appearance of a Boltzmann factor describing the particle populations and a frequency term corresponding to the quantized transitions induced between the energy levels of the box. It is shown that for particle transition frequencies, $\omega_{\nu\nu'}$, which are less than or equal to spin transition frequencies, $\omega_s \pm \omega_n$, the quantum mechanical spectral densities reduce to those of the semiclassical jump model. As the temperature is reduced below 20°K the ENDOR line shape expected from the "box" model is shown to resemble that of a matrix ENDOR signal. At very low temperatures a change in both the ENDOR line shapes and intensities is predicted. (auth)

47280 MOESSBAUER EFFECT STUDIES OF ^{57}Co AND ^{57}Fe IN β-RHOMBOHEDRAL BORON. Stanke, F.; Parak, F. (Technische Univ., Munich). Phys. Status Solidi (b); 52: No. 1, 69-77(1 Jul 1972).

The behavior of ^{57}Fe- and ^{57}Co-doped β-rhombohedral boron was investigated by means of Moessbauer spectroscopy. Samples prepared by diffusing ^{57}Fe at temperatures above 1000°C and ^{57}Co at temperatures of 1500°C or higher showed a reproducible quadrupole interaction and a strongly anisotropic f-factor. Using combinations of the different parameters obtained from the spectra, it was attempted to determine the position of the impurities. There is some evidence for an incorporation within the 28-atom subgroup. It was found that the sites occupied by Co and Fe do not have a C_{5v} point symmetry. (auth)

47281 NUCLEAR MAGNETIC RESONANCE IN THE LaX_3 INTERMETALLIC COMPOUNDS. Welsh, L. B. (Northwestern Univ., Evanston, Ill.); Toxen, A. M.; Gambino, R. J. Phys. Rev., B; 6: No. 5, 1677-85(1 Sep 1972).

The ^{139}La NMR Knight shift and spin-lattice relaxation time (T_1) in $LaPb_3$ were measured from 1.5 to 300°K. The isotropic and anisotropic ^{207}Pb Knight shifts were measured at 1.5, 4.2, and 77°K and T_1 was measured at 1.55°K. Also presented are measurements of the La T_1 in $LaIn_3$ from 1.5 to 300°K which are more complete than previously reported. These measurements are compared with previously reported measurements for $LaSn_3$. The ^{139}La Knight shift (+0.010% at 4.2°K) in $LaPb_3$ has a temperature dependence roughly five times that found in $LaSn_3$ and $LaIn_3$ even though the bulk susceptibility is considerably smaller. For $LaPb_3$, the La T_1T product is nearly temperature independent (T_1T = 0.59 sec°K at 4.2°K) and is about half that found in $LaSn_3$. For $LaIn_3$, T_1T increases by 50% between 1.5 and 300°K and has a temperature dependence similar to $LaSn_3$. The isotropic and anisotropic Pb Knight shifts (K_{iso} = +0.70% and $3K_{ax}$ = + 0.43% at 4.2°K) are nearly temperature independent. The Pb relaxation time in $LaPb_3$ ($T_1T = 63 \times 10^{-4}$ sec°K) is about four times faster than in Pb metal, indicating a larger s-contact contribution than in Pb metal and a large negative Knight-shift component. The La NMR and bulk-susceptibility data are partitioned using the customary approximation for transition metals. The results for $LaIn_3$ and $LaSn_3$ are quite similar, suggesting that in both these materials the La d-orbital susceptibility is much larger than the d-spin susceptibility and that exchange-enhancement effects are probably not important. For $LaPb_3$, d-orbital effects are less important than the d-spin contributions. In all three compounds, the La d-spin contributions to the NMR properties and the bulk susceptibility are of similar magnitude. (auth)

47282 DETERMINATION OF THE BACKGROUND OF MOESSBAUER TRANSMISSION EXPERIMENTS USING IRON ALLOYS WITH 3d-TRANSITION ELEMENTS. Semenkin, V. A.; Shevchenko, Yu. A. (Ural Polytechnic Inst., Sverdlovsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 6, 1659-61 (1971).

Translated from Prib. Tekh. Eksp.; 14: No. 6, 67-9(1971).

The background development mechanism and the principal sources of errors in the absolute measurement of Moessbauer-effect probability are described, and estimates of their magnitudes are presented. A procedure is described for simultaneous measurement of (a) multiple Compton scattering in the absorber, and (b) the fraction of high-energy radiation which falls in the "window" that cuts out the resonance peak. (auth)

PHYSICS (THEORETICAL)

Refer also to abstract: 46671.

47283 (CERN–72–8) METHODS OF NONLINEAR ANALYSIS. Brown, Clifford C.; Wehrl, Alfred (European Organization for Nuclear Research, Geneva (Switzerland)). 24 May 1972. 47p. Dep. NTIS (U. S. Sales Only).

The topics discussed are the Banach and Brouwer–Schauder fixed-point theorems, fixed points of groups, semigroups of transformations, and the local degree of a continuous mapping including the basic concepts, applications, and infinite-dimensional spaces. (J.F.P.)

47284 (IC–72/45) ASYMPTOTIC NUMBERS: ONE GENERALIZATION OF THE NOTION OF NUMBER. Christov, Chr.; Todorov, T. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1972. 14p. Dep. NTIS (U. S. Sales Only).

An algebra is proposed whose elements are called power asymptotic numbers. Every number is represented by one class of sequences—functions a(s) with power expansion in the neighborhood of the point s = 0, which have fixed coefficients and arbitrary residual terms. A function with power expansion is a function of the form $a(s) = s^{\mu}\varphi(s)$ where $\varphi(s)$ has derivatives up to a given order $\lambda(\lambda = 0, 1, 2, -\infty)$. (According to Taylor's theorem, functions of that kind can be expanded in power series.) Several properties of these numbers are established. The power asymptotic numbers are objects interesting in themselves, but they are also auxiliary quantities useful for the introduction of the asymptotic functions—a new variant of generalized functions, quite analogous to the distributions of Sobolev–Schwartz but allowing the operation of multiplication. The final aim is to develop an elaborate method for operations with nonnormalizable wave functions in quantum mechanics, necessary, for example, for the investigation of the connection between scattering matrix and cross section. (auth)

47285 (ITF–71–101–P) IMPOSSIBILITY OF INTRODUCING THE "HIDDEN" PARAMETERS INTO QUANTUM MECHANICS. Akhiezer, A. I.; Polovin, R. V. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 44p. (In Russian). Dep. NTIS (U. S. Sales Only).

Increased interest has recently been displayed in the gnosiological foundations of quantum mechanics, in the first place for von Neiman's theorem about the impossibility of introducing the so-called "hidden" parameters into the quantum mechanics. The most simple and transparent proofs of this fundamental theorem are given. The above is preceded by a brief account of basic quantum mechanics, including the measurement process. (auth)

47286 (LYCEN–7202) GENERATING FUNCTION METHOD AND DEVELOPMENTS IN QUASI-BOSON. Hage-Hassan, M.; Lambert, M. (Lyon Univ. (France). Institut de Physique Nucleaire). Jan 1972. 27p. (In French). Dep. NTIS (U. S. Sales Only).

An isomorphism between the H′ subspace of physically bound states and a normalized F functional space is established. This is accomplished by introducing a generating function of the H′ states. By adopting a Bargmann space for the F space, an isomorphism is obtained between the H_F space of the fermion states and the H_B space of the boson states. An expansion of any quasi-boson operator of H_B is thus feasible. This is particularly interesting for the Hamiltonian operator. In this case an expansion is obtained which is similar to the Beliaev–Zelevinski and Marumori expansions, but more simple and more convergent. (France)

47287 (ORNL–4778) KWIC INDEX FOR NUMERICAL ALGEBRA. Householder, A. S. (Oak Ridge National Lab., Tenn.). Jun 1972. Contract W-7405-eng-26. 538p. Dep. NTIS.

This listing combines, updates, and otherwise augments those issued previously in three separate volumes, two dealing with linear algebra and one on nonlinear algebraic and transcendental equations. The intention was to list recent literature and selected older classics that have a possible interest for those working in this branch of numerical analysis. (auth)

47288 USE OF A QUASI-CLASSICAL APPROXIMATION FOR THE SOLUTION OF A SYSTEM OF HARTREE–FOCK EQUATION. Gataullin, R.; Arifov, P. U. (Inst. of Electronics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 4, 58–62(1971). (In Russian).

With the integrol-differential Hartree–Fock equations as a basis, it was shown that valid quasi-classical conditions of quantization with high accuracy are obtained so that numerical solutions may be derived with an electronic computer for the plotting of λ_{quant}. The value λ_{quant} thus obtained may be used for subsequent refinement by Ridley's formula. (3 figures, 1 table) (K.S.W.)

47289 GENERAL FORMULA FOR OBTAINING EXPECTATION VALUES FROM THE HYPERCHARACTERISTIC FUNCTION. Rosen, G. (Drexel Univ., Philadelphia). Lett. Nuovo Cim.; 4: No. 9, 391–2(1 Jul 1972).

Comments are made on a previous derivation of quantum-mechanical expectation values from the hypercharacteristic function (Shankara: Lett. Nuovo Cimento: 4; 867(1970)). (auth)

47290 IMPROVEMENTS ON A NEW METHOD FOR THE NUMERICAL SOLUTION OF THE SCHROEDINGER EQUATION. Grimm, R. C.; Storer, R. G.; Davies, B. (Flinders Univ. of South Australia, Bedford Park). J. Comput. Phys.; 9: No. 3, 538–46(Jun 1972).

Two procedures are described for improving the accuracy and efficiency of a method recently proposed for the numerical solution of the bound state Schrödinger equation. Firstly, an analysis of the errors in the method dictates the most efficient way for obtaining accurate results and also allows for the use of extrapolation techniques. Secondly, an expansion around the solution for a harmonic oscillator potential yields a more rapidly convergent procedure. Illustrations for a simple one-dimensional potential are given. (auth)

47291 UNITARY OPERATOR FORM OF THE GENERAL BOGOLYUBOV–TYABLIKOV TRANSFORMATION. Zietek, W. J. (Inst. for Low Temperature and Structure Research, Wroclaw). Phys. Lett.; 40A: No. 2, 139–40(3 Jul 1972).

The unitary operators corresponding to the general Bogolyubov-Tyablikov transformation for Bose as well as Fermi operators are determined and some special cases are discussed. (auth)

47292 INCOMPATIBILITY OF GAUGE INVARIANCE AND NONRELATIVISTIC LOCALITY IN PATH INTEGRAL FORMULATION. Patera, J. (Univ. of Montreal). J. Statist. Phys.; 5: No. 3, 185–8(1972).

It is shown that a modification of the usual gauge transformation is essential to the path integral formulation of nonrelativistic quantum mechanics as a consequence of defining the locality condition as follows: The contribution from each path comes entirely from the points on the path. Arguments are based on the similarity between Wiener and Feynman functional (path) integrals. (auth)

47293 FINITE DIFFERENCE SCHROEDINGER EQUATION. Meessen, A. (Louvain Univ., Belgium). Ann. Soc. Sci. Brux. Ser. I: 86: No. 1, 89–100(1972).

To avoid any arbitrariness, one should consider the ultimate limit for the smallest measurable distance as an unknown quantity, whose value could be finite as well as zero. This implies that the usual differential equations of quantum mechanics should be considered as limiting cases of some adequate finite difference equations. The "correspondence principle" which allows one to set up these finite difference equations, is justified by checking the internal consistency of the theory, in the case where the light velocity $c = \infty$. (auth)

47294 COVERING LAW IN QUANTAL PROPOSITION SYSTEMS. Ochs, Wilhelm (Univ., Munich). Commun. Math. Phys.; 25: No. 3, 245–52(1972).

A recent justification of the covering law by Jauch and Piron founded on the existence of ideal measurements of the first kind is shown to contain a gap. This gap is closed by an additional assumption about such measurements. (auth)

47295 AXIOMS OF QUANTUM MECHANICS. Bugajska, K.; Bugajski, S. (Silesian Univ., Katowice, Poland). Bull. Acad. Pol. Sci., Ser. Sci. Math., Astron. Phys.; 20: No. 3, 231–4(1972).

The lattice postulate is eliminated from Zierler's axiomatic scheme by proving that the postulate is a consequence of some other axioms. The result may serve as justification of the "critical" lattice assumption of the logical approach. (auth)

47296 REMARKS ON THE THREE BODY PROBLEM IN QUANTUM MECHANICS. Makai, E. (Mathematical Inst., Budapest). Stud. Sci. Math. Hung.; 6: No. 3–4, 467–80(1971).

Some solutions of the Schroedinger equation of the quantum mechanical three body problem are found avoiding group-theoretical methods. The solutions have the form of power series expansions. (J.F.P.)

47297 POSSIBLE GENERALIZATION OF NONRELATIVISTIC QUANTUM MECHANICS. Kuryshkin, V. V. (Institut de France, Paris). Compt. Rend., Ser. B; 274: No. 20, 1107-10 (15 May 1972). (In French).

The different attempts made to construct a new theory which would provide a deterministic description of quantum processes and have statistical properties that coincide with the usual quantum mechanics are reviewed and discussed. (France)

47298 VARIATIONAL PRINCIPLE FOR NONLINEAR LAGRANGIAN IN QUANTUM MECHANICS. Ohtani, Teruya; Sugano, Reiji (Okaka City Univ.). Progr. Theor. Phys. (Kyoto); 47: No. 5, 1704-13(May 1972).

The variation principle has not been well defined in quantum mechanics for a Lagrangian containing a velocity dependent potential. The method of variation is investigated to derive an Euler–Lagrange equation in connection with Noether's theorem when the Lagrangian is invariant under some point transformation. Obtained are the Euler-Lagrange equation retaining the above invariance by means of the variation method and the Hamiltonian with which the canonical equation of motion leads to the Euler–Lagrange equation. (auth)

47299 LECTURES ON QUANTUM STATISTICS. VOLUME 2. QUASI-AVERAGES. Bogolyubov, N. N. New York; Gordon and Breach, Science Publishers, Inc. (1970). 237p.

Translated from the Russian by L. Klein and S. Glass.

The concept is introduced of a quasi average and of thermodynamic Green's functions defined with quasi averages. These quasi averages are thermal averages with a symmetry breaking term introduced into the Hamiltonian. This results in a violation of a conservation law and allows nonzero results to be obtained for the quantities of interest. This method is applied to problems of the spontaneous magnetization of the Heisenberg ferromagnet, the crystal lattice, and, in an extensive treatment, the superconductor. The model Hamiltonian for superconductivity theory is examined and bounds for the eigenvalues are obtained. The hydrodynamic equations for superfluids are derived and the corresponding Green's functions are examined. The self consistent field method is related to the method of compensation of dangerous diagrams. (M.H.R.)

REACTOR TECHNOLOGY

Power Reactor Development

Refer also to abstracts: 45181, 45288, and 45439.

47300 ATOMIC ENERGY IN INDIA. Grenon, Michel. Rev. Fr. Energ.; 23: No. 239, 246-57(Feb 1972). (In French).

The structure of the energy sources of India is reviewed. The various aspects of the Indian electronuclear program are then studied. Although India possesses modest U reserves, she possesses the world's largest Th reserves. In spite of this, the preliminary phase of the nuclear program was upon the Canadian natural U, heavy-water, reactor series (Candu), a type of reactor having a very high Pu yield. An interest exists in fast reactors using Th fuel as well as in breeder reactors using this fuel. Mining, fuel manufacture industries, and heavy water production and irradiated fuel reprocessing plants were developed independently of the reactor construction program. (France)

47301 REACTOR TECHNOLOGY. VOLUME 15, NUMBER 2. One of Four Technical Progress Reviews Published for the Technical Information Center, USAEC. Washington, D. C.; Atomic Energy Commission (1972). 98p. $0.75.

Four review articles are presented on various aspects of reactor design, fuels, and components. A separate abstract was prepared for each article. (H.D.R.)

For abstracts of individual papers see: 45960, 47211, 47302, and 47303.

47302 DEVELOPMENT OF MATERIALS AND SYSTEMS FOR THE MOLTEN-SALT REACTOR CONCEPT. MacPherson, H. G. (Univ. of Tennessee, Knoxville). Reactor Technol.; 15: No. 2, 136-55(1972).

Interest in molten-salt-fueled reactors stems largely from the ease and relatively low cost of purifying and reconstituting the fuel. Molten-salt thermal breeder reactors—graphite moderated and with salt constituents that absorb few neutrons—will have low enough inventories and doubling times to greatly ease the future requirements for uranium mining and for enrichment facilities. Among the reactor designs that have been studied, the favorite is a single-fluid breeder fueled with a mixture of ^{7}LiF, BeF_2, ThF_4, and $^{233}UF_4$. The chemical characteristics of such salts and the behavior of fission products in them are quite well understood from many years of research and from the operation of the Molten Salt Reactor Experiment (MSRE). A number of processes for removing the soluble fission products (and protactinium) from the salt have been explored. Of these, reductive extraction into bismuth is being developed most vigorously. A bubble generator and centrifugal gas stripper are being developed to ensure the speedy removal of the noble-gas fission products, which are only sparingly soluble. Unresolved problems receiving attention include the control of tritium arising from neutron reactions with lithium, surface fissures in Hastelloy N probably arising from fission-product attack, the retention of the radiation resistance of Hastelloy N to high temperatures, and the development of a steam generator. (101 references) (auth)

47303 EFFECTS OF METAL SWELLING AND CREEP ON FAST REACTOR DESIGN AND PERFORMANCE. Huebotter, Paul R. (Argonne National Lab., Ill.). Reactor Technol.; 15: No. 2, 156-83(1972).

Dimensional instability of stainless steel, due to radiation-induced swelling and radiation-enhanced creep, profoundly affects the design and performance of fast reactors. The design literature is reviewed in an attempt to clarify the impact of swelling and creep and to scope the options available for accommodating these fast-neutron irradiation effects. The problems of swelling and creep are stated for selected reactor components, and contemporary-design thinking on each component is presented. The subject is then discussed on a reactor-by-reactor basis with either a summary description of the design strategy to accommodate swelling and creep or, in the case of reactors designed prior to discovery of these phenomena, the impact of swelling and creep that has been experienced or is foreseen. Finally the probable effect of swelling and creep on fast reactor economics is conjectured. This effect is translated into an incentive for research and development focused toward a metallurgical solution to the problem (14 references) (auth)

47304 STUDY OF THE MECHANICAL AND THERMAL BEHAVIOR OF A HIGH TEMPERATURE REACTOR CORE. Felten, P.; Gros, G.; Malherbe, J. (CEN de Saclay, Gif-sur-Yvette, France). Bull. Inform. Sci. Tech. (Paris); No. 167, 7-19(Feb 1972). (In French).

The various thermal and mechanical problems relating to the core of a prismatic element HTR are analyzed (assembling and handling of the blocks, dimensional changes induced by graphite irradiation, fuel performance, gas leaks through the stack). A possible core is presented. The behavior of two different types of fuel elements in this core is examined. (France)

Physics and Core Engineering

Refer also to abstracts: 47581 and 47585.

47305 (ORNL-TM-3832) DESIGN STUDIES OF A MOLTEN-SALT REACTOR DEMONSTRATION PLANT. Bettis, E. S.; Alexander, L. G.; Watts, H. L. (Oak Ridge National Lab., Tenn.). Jun 1972. Contract W-7405-eng-26. 69p. Dep. NTIS.

The MSDR, a 350-MW(e) Molten-Salt Reactor Demonstration Reactor, is based on technology much of which was demonstrated by the MSRE. The cylindrical vessel (26 ft diam by 26 ft high) houses a matrix of graphite slabs forming salt passages having a volume fraction in the core of 10%. The flow of fuel salt is distributed so that the temperature rise along any path is the same—from 1050 to 1250°F. In the primary exchanger, heat is transferred to barren carrier salt (in at 900°F, out at 1100°F). In the secondary exchanger, heat is transferred to a stream of Hitec salt (in at 800°F, out at 1000°F). The Hitec oxidizes tritium to tritiated water which is removed and disposed of. The Hitec generates steam at 900°F, 2400 psi in a boiler, superheater, and reheater. Electricity is produced at an overall efficiency of 36.6%. Soluble fission products are removed by discarding the carrier salt every 8 years after recovery of the uranium by fluorination. Volatile fission products are removed by sparging the fuel salt with helium bubbles in the reactor primary system. The fuel cycle cost was estimated to 0.7 mill/kWhr for inventory, 0.3 mill/kWhr for replacement, and 0.1 mill/kWhr for processing, giving a total of 1.1 mills/kWhr. (auth)

47306 BURNUP AND POWER SHIFT EFFECTS IN LARGE FAST BREEDER REACTORS. Philbin, J. S. (Sandia Labs., Albuquerque, N. Mex.); Axford, R. A. Nucl. Technol.; 15: No. 3, 327-42(Sep 1972).

A method for analyzing the changes in the neutronic characteristics of large fast reactors during long-term operation is developed. The non-uniform buildup and depletion of the fuel nuclides is taken into account by using eigenfunction expansions in the solution of the one-dimensional, multigroup diffusion equations. A refueling scheme is introduced in order to study the behavior over many reloading cycles as well as between two loading events. The depletion of fissile nuclides in the core and the buildup of fissile nuclides in the blanket cause a power shift into the blanket. The effect of this power shift upon the breeding ratio, the power density, and the reactivity coefficients of a large mixed oxide fast reactor is explored in detail. The power shift into the blanket during the approach to equilibrium is 1.55% of the total reactor power. The breeding ratio increases by only 0.56% during reactor operation. The sodium void coefficient increases by 11.2% from startup to the end of an equilibrium period. The Doppler coefficient, which changes only slightly during the approach to equilibrium, becomes more negative. The total change in the Doppler coefficient is less than 2%. 35 references. (auth)

47307 ON-LINE REACTIVITY FEEDBACK ANALYSIS OF EBR-II BY ROD DROP. Larson, H. A. (Argonne National Lab., Idaho Falls, Idaho); Engen, I. A. Nucl. Technol.; 15: No. 3, 462-4(Sep 1972).

Reactivity feedback is an important indicator in the analysis of the dynamic behavior of a nuclear reactor. The rod-drop perturbation method is used at EBR-II to produce time-dependent power data which is processed with an on-line digital data reduction procedure to produce time-dependent reactivity feedback; reactivity feedback models are defined in the time and frequency domains. This streamlined procedure has resulted in decreased data reduction time and manpower requirements along with increased data integrity. 12 references. (auth)

Control and Instrumentation

47308 REGULATION OF THE WATER-STEAM CIRCUIT OF A NUCLEAR POWER STATION. A ONCE-THROUGH STEAM GENERATOR WITHOUT BOILER. Barber, P. (CEN de Saclay, Gif-sur-Yvette, France). Bull. Inform. Sci. Tech. (Paris); No. 167, 21-7(Feb 1972). (In French).

The logical process leading to the choice of control system for the water–steam circuit of a power station is exposed. Particular attention is given to the problems of dimensions which arise in the case of the steam generator of a high-temperature reactor. (France)

Coolant System

47309 (CISE-R-257) DIGITAL PROGRAMS FOR THE STUDY OF THE THERMOHYDRAULIC BEHAVIOR OF THE PRIMARY CIRCUIT OF THE REACTOR CIRENE (PECVAR, CRIP). Muscettola, M. (Centro Informazioni Studi Esperienze, Milan (Italy)). Sep 1968. 221p. (In Italian). Dep. NTIS (U. S. Sales Only).

The characteristics and differences of the various digital programs set up at CISE for the study of the thermo-hydraulic behavior of the primary circuit of the CIRENE nuclear reactor are summarized. The program PECVAR and the program CRIP are thoroughly described. The program PECVAR computes a detailed profile of pressure along the portion of circuit including the feeders, the channel with the bottom and top end-fittings, the risers and the steam–water separators. It also computes mean densities and mass and energy content in the channels and the safety margin with respect to the heat transfer crisis. The program CRIP computes the water and steam mass flow rate distribution among the various channels when, for a given geometry, the thermal power, the drum pressure, the steam feeder header pressure and the total mass flow rate of the recirculated water are imposed. In this calculation the overall energy and mass balance of the primary circuit is taken into account. 11 references. (auth)

47310 STUDY OF PRESSURE FLUCTUATIONS GENERATED BY AERODYNAMIC SINGULARITIES IN A CIRCUIT. Gibert, R. J. (CEN de Saclay, Gif-sur-Yvette, France). Bull. I Inform. Sci. Tech. (Paris); No. 167, 33-9(Feb 1972). (In French).

Incidents that have occurred in various nuclear power reactors emphasize the problems that can arise from pressure and speed fluctuations in the primary and secondary circuits of the reactor and the corresponding induced vibrations. Certain singularities giving rise to fluctuations (local instabilities and the corresponding acoustic phenomena) were studied experimentally. A calculation on the transmission of such vibrations throughout the circuit is presented. (France)

47311 REINFORCED CONCRETE VESSELS FOR NUCLEAR POWER REACTORS: PRESENT STATUS AND FUTURE TRENDS. Balanescu, M. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 24: No. 4, 401-23(1972). (In Rumanian).

French and English developments for the graphite-gas reactor line have demonstrated that the design and erection of a concrete calandria of the size required for power reactors do not raise any basic difficulty. Given the already known techniques and methods of building, it is considered that for high temperature or fast neutron commercial reactors, steel pressure vessels should no more be adopted, the future belonging to the prestressed reinforced concrete ones. The development status of the prestressed reinforced concrete calandria for water reactors, the difficulties pertaining to this line, as well as the proposed solutions, are reviewed. (auth)

Fuels and Fuel Elements

47312 (CONF-720802-1) HEAT TRANSFER PERFORMANCE OF SHORT TWISTED TAPES. Klepper, O. H. (Oak Ridge National Lab., Tenn.). [1971]. 23p. Dep. NTIS.

For Presentation at 13. national heat transfer conference; Denver, CO, (6 Aug 1972).

The use of a short twisted tape extending over a portion of a tube's heated length to enhance the heat transfer to a gas flowing within the tube was investigated with emphasis on the vortex decay region downstream from the tape. This problem is of particular significance to the cooling of high-performance gas-cooled nuclear reactors. Heat-transfer and pressure-drop data were obtained using nitrogen gas to cool tubes heated by an electric current passing axially through the tube wall. Tape twists (measured as the ratio of the tube length per 180-degree tape twist to the tube diameter) varied from 2.38 to 8.05; Reynolds moduli ranged from 20,000 to 380,000; and wall-to-gas absolute temperature ratios from 1.0 to 2.1. Results are presented. 13 references. (auth)

47313 SPACE-ENERGY-DEPENDENT PHYSICS PROBLEMS OF PLUTONIUM FUELS IN HTGRs. Asmussen, Keith E.; Waelti, Paul (Gulf General Atomic, San Diego, Calif.). Nucl. Technol.; 15: No. 3, 359-65(Sep 1972).

The plutonium loadings for a test element for irradiation in the Peach Bottom HTGR were determined. The test element is a graphite circular cylinder with an array of eight fuel rods in a circular pattern. The fuel rods contain dense spherical kernels of PuO_2 or $PuO_2/3\ ThO_2$. Because of the strong Pu resonances, the heterogeneity effects in the test element are strongly marked. A code for treating this rather complicated problem rigorously was not available. Thus the problem was simulated within a one-dimensional transport code by equating three collision probabilities. The heterogeneities were seen to result in significant grain self-shielding, rod self-shielding and mutual shielding of the rods. The Pu loading for the central fuel body of the test element was determined to be 19.0 grams. 12 references. (auth)

47314 STUDY OF VIBRATIONS OF THE CENTERING PARTS OF FUEL ELEMENT CARTRIDGES. Livolant, M.; Hoffmann, A. (CEN de Saclay, Gif-sur-Yvette, France). Bull. Inform. Sci. Tech. (Paris); No. 167, 29-32(Feb 1972). (In French).

In a nuclear reactor of the natural uranium–graphite–gas type, the highly pressurized cooling fluid flows at great speed along the fuel cartridges which are held in the center of the channel by light alloy elements: the centering parts. The pressure fluctuations generated by the flow instability produce random stresses in these centering parts. Under particular conditions this has resulted in rupture due to metal fatigue. The extensive program undertaken by the CEA to study these phenomena is reviewed. (France)

Operation and Economics

47315 (CISE-R-178) ACTUAL VALUE METHOD EVALUATION OF THE EFFECTS OF FUEL COSTS ON THE COST OF POWER PRODUCED BY A NUCLEAR REACTOR FOR THE CASE OF BATCH REFUELING AND FOR THE CASE OF CONTINUOUS REFUELING. Astolfi, A. (Centro Informazioni Studi Esperienze, Milan (Italy)). Oct 1966. 59p. (In Italian). Dep. NTIS (U. S. Sales Only).

Using the present-worth method, the derivation of fuel cost expressions accounting for all fuel expenditures during the entire life of the power station in both cases of batch and continuous loading is shown. The resulting expressions are applied for calculating the fuel cost for the metallic and oxide uranium fuelled reactors of the CIRENE program. In the case of continuous loading a simple approximate procedure to estimate the capital invested in the fuel cycle and its interest charges is also presented. (auth)

47316 FAST BREEDER: SCHEDULE LENGTHENS, COST ESCALATES. Olds, F. C. Power Eng.; 76: No. 6, 33-5(Jun 1972).

The timetable for the U. S. LMFBR program is examined. The effects of delays on estimated costs are discussed. (H.D.R.)

Safety and Siting

47317 (BNWL-1635) TECHNOLOGICAL CONSIDERATIONS IN EMERGENCY INSTRUMENTATION PREPAREDNESS. Phase II-A. Emergency Radiological and Meteorological Instrumentation Criteria for Reactors. Selby, J. M.; Andersen, B. V.; Carter, L. A.; Corley, J. P.; Elderkin, C. E.; Kathren, R. L.; Schwendiman, L. C.; Unruh, C. M.; Watson, E. C.; Woodruff, R. K. (Battelle Pacific Northwest Labs., Richland, Wash.). May 1972. Contract AT(45-1)-1830. 125p. Dep. NTIS.

Criteria for several instrument and instrumentation systems are presented. These include: (1) Liquid and gaseous radiological effluent monitoring instrumentation, both within the facility and in the environs. (2) Ambient radiation monitoring instrumentation. (3) Portable radiological monitoring instrumentation. (4) Meteorological instrumentation, both for synoptic and predictive purposes. The criteria are for instrumentation for determining the nature and extent of a radiological incident immediately after its occurrence. Emergency instrumentation criteria are examined for the contemporary reactor, in consonance with what is needed, reasonable, and achievable with the state-of-the-art, while at the same time identifying areas in which additional study is indicated. Before criteria for reactor emergency instrumentation could be developed, it was necessary to establish the maximum fission product inventory which could be involved in an accident, and also to make certain assumptions about the fraction of the inventory which might escape from the core. Once the fission products were characterized, instrumentation requirements for quickly assessing the release and predicting the trajectory and airborne concentration downwind were defined. Based on the quantity and characterization of airborne fission products which could escape, guides to instrument selection are given along with criteria for performance and placement, and some techniques presented for estimating the magnitude of the release. Instrumentation for meteorological parameter measurement is considered in detail because of the important role such measure-

ments will play in determining the direction of flow and dispersion in the atmosphere, and in the initial response by monitoring personnel. 115 references. (auth)

47318 (RT/PROT-72-4) DECAT: COMPUTER CODE FOR ANALYSIS OF THE LONG TERM PRESSURE AND TEMPERATURE TRANSIENT AFTER A LOSS OF COOLANT ACCIDENT IN A G.E. TYPE PRESSURE SUPPRESSION CONTAINMENT. Morici, A.; Santarossa, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 23 Feb 1972. 33p. (In Italian). Dep. NTIS (U. S. Sales Only).

The necessary input data are given and the use of the code for the calculation of the maximum values of pressure and temperature is illustrated with the aid of a test case. The analytical model is given. A listing is included and the nomenclature is given with the symbols used in the computer language. (auth)

Commercial Power Reactors

Refer also to abstract: 47579.

Physics and Core Engineering

Refer also to abstract: 47595.

47319 (GULF-GA-B-10959) COMPUTER SIMULATION OF PULSED-NEUTRON EXPERIMENTS FOR THE FORT ST. VRAIN HTGR. Pfeiffer, Wayne (Gulf General Atomic Co., San Diego, Calif.). 29 Mar 1972. Contract AT(04-3)-633. 40p. Dep. NTIS.

Prior to startup of the 330 MW Fort St. Vrain HTGR, pulsed-neutron experiments will be performed to determine the reactivity for various subcritical, control rod configurations. To determine the reactivity, the inhour method will be used. This method requires that the time response following the pulse exhibit the die-away of the fundamental prompt mode. For such a large reactor, it is important to carefully position the source and detector in order to minimize the contribution of the higher prompt modes to the time response. Moreover, for a power reactor, economics dictates that the optimum source and detector locations be determined before the experiments. This can be done by simulating the experiments on a computer. Such computer simulations have been performed for all ten control rod configurations for which pulsing is planned. The optimum source and detector locations have been determined as well as the expected time responses. 11 references. (auth)

Control and Instrumentation

47320 (DOCKET-50003-118) INDIAN POINT STATION, UNIT 1. Measures Taken to Repair Control Rod and Safety Implications of the Incident. (Consolidated Edison Co. of New York, Inc., New York). 10 Jul 1972. 9p. Dep. NTIS.

47321 (DOCKET-50244-109) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Loss of Rod Control Logic System Power Supply. (Rochester Gas and Electric Corp., N. Y.). 7 Aug 1972. 2p. Dep. NTIS.

47322 (DOCKET-50247-77) INDIAN POINT NUCLEAR GENERATING UNIT 2. Summary Report of Control Rod Drive Line Malfunction. (Consolidated Edison Co. of New York, Inc., New York). 2 Aug 1972. 9p. Dep. NTIS.

47323 (DOCKET-50263-141) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Supplemental Letter to the May 25, 1972 Report of Low APRM Gain Setting. (Northern States Power Co., Minneapolis, Minn.). 4 Aug 1972. 2p. Dep. NTIS.

47324 ANALOG STUDIES OF THE DYNAMICS OF A POWER PLANT CONTROL SYSTEM INCORPORATING A 440 MW(e) REACTOR. Golyand, L. N.; Dunaevskii, S. Ya.; Ostashenko, V. F.; Afanas'eva, T. M. This paper was summarized in At. Energ. (USSR); 30: No. 1, 44(Jan 1971) as paper No. 453/5856. (In Russian).

Results of analog simulation studies of the dynamics of the control system for a power plant unit incorporating the V-440 reactor are presented. The reliability of the results obtained in the analog simulation are confirmed by experiments conducted on real equipment (the first and second power units of the Novaya Voronezh' nuclear power plant). Transients in the control system of the first and second power units are compared to the simulation results, with the power output brought down to 70 and to 120 MW respectively. The simulation accuracy was estimated in neutron flux at 3–5% rating, in terms of pressure to about 1 atm, in terms of coolant temperature to within 1–2°C. The static characteristics of the third power unit of the Novaya Voronezh' nuclear power plant (with the V-440 reactor) are presented along with the dynamic characteristics of the unit, the latter including the speed at which the reactor is brought up to full power, the extent to which reactor parameters are smoothed out automatically, and delay times, in response to reactivity surges and turbogenerator loads. The characteristics are reported for different power output levels and different reactivity coefficients with respect to coolant temperature. The dynamic characteristics of the third power unit in response to a stepwise drop in station power output from 100% to 50%, with a relay type controller acting on the reactor control rods in a constant-speed mode, are discussed. (auth)

Containment Systems, Waste Processing, and Radiation Protection

47325 (DOCKET-50265-101) QUAD-CITIES STATION, UNIT 2. Timer Found to be Inoperable. (Commonwealth Edison Co., Chicago, Ill.). 13 Aug 1972. 1p. Dep. NTIS.

47326 (DOCKET-50346-30) DAVIS-BESSE NUCLEAR POWER STATION. Shipping Damage to Containment Vessel Equipment Hatch. (Directorate of Regulatory Operations (AEC), Washington, D. C.). 9 Aug 1972. 4p. Dep. NTIS.

Coolant System

47327 (DOCKET-50016-160) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Execution of Periodic Test Activity Delayed by Piping Installation. (Power Reactor Development Co., Detroit, Mich.). 7 Jul 1972. 1p. Dep. NTIS.

47328 (DOCKET-50280-78) SURRY POWER STATION, UNIT 1. Authorization Request to Drain Reactor Coolant System Water and Lower Water Level in Reactor Vessel. (Virginia Electric and Power Co., Richmond). 4 Aug 1972. 2p. Dep. NTIS.

47329 (DOCKET-50341-44) ENRICO FERMI ATOMIC POWER PLANT, UNIT 2. Reactor Pressure Vessel Ultrasonic Indications. (Directorate of Regulatory Operations (AEC), Washington, D. C.). 3 Aug 1972. 3p. Dep. NTIS.

47330 (DOCKET-50409-7) LA CROSSE BOILING WATER REACTOR. Forced Circulation System Behavior. (Dairyland Power Cooperative, La Crosse, Wis.). 14 Jul 1972. 2p. Dep. NTIS.

Auxiliary Systems and Engineered Safeguards

47331 (DOCKET-50237-250) DRESDEN NUCLEAR POWER STATION, UNIT 2. Failure of No. 2 Diesel Generator. (Commonwealth Edison Co., Morris, Ill. (USA)). 25 Jul 1972. 2p. Dep. NTIS.

47332 (DOCKET-50249-148) DRESDEN NUCLEAR POWER STATION, UNIT 3. Reactor Pressure Scram Switch Drifted. (Commonwealth Edison Co., Chicago, Ill.). 1 Aug 1972. 2p. Dep. NTIS.

47333 (DOCKET-50263-142) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. HPCI Turbine Check Valve Leakage. (Northern States Power Co., Minneapolis, Minn.). 4 Aug 1972. 1p. Dep. NTIS.

47334 (DOCKET-50263-143) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Fast Start Failure of the High Pressure Coolant Injection System. (Northern States Power Co., Minneapolis, Minn.). 3 Aug 1972. 1p. Dep. NTIS.

47335 (DOCKET-50265-100) QUAD-CITIES STATION, UNIT 2. Failure of Inboard Primary Containment Isolation Valve in the Reactor Core Isolation Cooling System. (Commonwealth Edison Co., Cordova, Ill.). 3 Aug 1972. 2p. Dep. NTIS.

Operation and Economics

47336 (DOCKET-1151-57) ELK RIVER REACTOR. Operating Authorization DPRA-3, Amendment 1. (United Power Association, Elk River, Minn. (USA)). 14 Jul 1972. 32p. Dep. NTIS.

The operating authorization for the Elk River Power Reactor is requested to be transferred from Rural Cooperative Power Association to United Power Association by virtue of a company merger. (H.D.R.)

47337 (DOCKET-50003-119) INDIAN POINT STATION, UNIT 1. Secondary Coolant Activity in Excess of 1.5×10^{-2}

μCi/ml. (Consolidated Edison Co. of New York, Inc., New York). 19 Jul 1972. 3p. Dep. NTIS.

47338 (DOCKET-50010-114) DRESDEN NUCLEAR POWER STATION, UNIT 1. Analysis of Minimum Hydro Test Requirements and Fluence Calculations. (Commonwealth Edison Co., Chicago, Ill.). 3 Aug 1972. 8p. Dep. NTIS.

Information is presented concerning the minimum hydro test temperature and the beltline neutron flux calculations for the pressure vessel. (D.C.C.)

47339 (DOCKET-50016-164) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Report for April 1972. (Power Reactor Development Co., Detroit, Mich.). 21 Jul 1972. 12p. (PRDC-EF-104). Dep. NTIS.

47340 (DOCKET-50016-165) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Failure to Measure Radioactivity of Sodium at Specified Times. (Power Reactor Development Co., Detroit, Mich.). 2 Aug 1972. 1p. Dep. NTIS.

47341 (DOCKET-50029-189) YANKEE NUCLEAR POWER STATION. Operation Report 138 for Month of June 1972. (Yankee Atomic Electric Co., Westboro, Mass.). 21 Jul 1972. 9p. Dep. NTIS.

47342 (DOCKET-50133-91) HUMBOLDT BAY POWER PLANT, UNIT 3. Transmission Tripped out of Service by Forest Fire. (Pacific Gas and Electric Co., San Francisco, Calif.). 14 Aug 1972. 2p. Dep. NTIS.

47343 (DOCKET-50213-154) HADDAM NECK PLANT, UNIT 1. Operation Report No. 72-6 for the Month of June 1972. (Connecticut Yankee Atomic Power Co., Haddam). 27 Jul 1972. Contract AT(30-1)-3144. 20p. (NYO-3144-72). Dep. NTIS.

47344 (DOCKET-50219-196) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Relay Failure. (Jersey Central Power and Light Co., Morristown, N. J.). 26 Jun 1972. 1p. Dep. NTIS.

47345 (DOCKET-50219-197) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Surveillance Test Failures. (Jersey Central Power and Light Co., Morristown, N. J.). 26 Jun 1972. 2p. Dep. NTIS.

The failure of the rubber expansion joint between the emergency service water pump and the discharge piping is described. The maintenance required for the main steam isolation valve is discussed. (D.C.C.)

47346 (DOCKET-50219-199) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Experience With the Rod Worth Minimizer. (Jersey Central Power and Light Co., Morristown, N. J.). 14 Jul 1972. 3p. Dep. NTIS.

47347 (DOCKET-50219-203) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Surveillance Failure. (Jersey Central Power and Light Co., Morristown, N. J.). 11 Aug 1972. 2p. Dep. NTIS.

The failure of an isolation condenser steam line high flow differential pressure instrument to trip at the normal trip point is described. (D.C.C.)

47348 (DOCKET-50219-204) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Containment Spray Pump Failure. (Jersey Central Power and Light Co., Morristown, N. J.). 11 Aug 1972. 2p. Dep. NTIS.

47349 (DOCKET-50220-100) NINE MILE POINT NUCLEAR STATION, UNIT 1. Malfunctions Which Occurred During the Periodic Testing of the Core Spray Systems. (Niagara Mohawk Power Corp., Lycoming, N. Y.). 24 Jul 1972. 4p. Dep. NTIS.

47350 (DOCKET-50220-101) NINE MILE POINT NUCLEAR STATION, UNIT 1. Delay in Delivery of Nitrogen Gas. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 1 Aug 1972. 2p. Dep. NTIS.

47351 (DOCKET-50220-103) NINE MILE POINT NUCLEAR STATION, UNIT 1. Technical Specifications, Proposed Changes. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 10 Aug 1972. 18p. Dep. NTIS.

Revisions are proposed in the Nine Mile Point Power Reactor, Unit 1 technical specifications by the incorporation of changes in the plant operating organization. (H.D.R.)

47352 (DOCKET-50237-245) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Drift in Calibration of Some of EHC Oil Pressure Scram Switches. (Commonwealth Edison Co., Morris, Ill. (USA)). 25 Jul 1972. 2p. (DOCKET-50249-143). Dep. NTIS.

47353 (DOCKET-50237-247) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Failure to Monitor Plant Chimney Effluents July 26, 1972. (Commonwealth Edison Co., Morris, Ill. (USA)). 26 Jul 1972. 1p. (DOCKET-50249-145). Dep. NTIS.

47354 (DOCKET-50237-248) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Oil Low Pressure Scram Switches Found to Have Drifted. (Commonwealth Edison Co., Chicago, Ill.). 27 Jul 1972. 2p. (DOCKET-50249-146). Dep. NTIS.

47355 (DOCKET-50237-251) DRESDEN NUCLEAR POWER STATION, UNIT 2. Proposed Change 10, Supplement. (Commonwealth Edison Co., Chicago, Ill.). 31 Jul 1972. 6p. Dep. NTIS.

The results of the Dresden Power Reactor Unit 2 inservice inspection performed during the second partial refueling outage are presented. (D.C.C.)

47356 (DOCKET-50237-252) DRESDEN NUCLEAR POWER STATION, UNIT 2. Sample Pump Tripped. (Commonwealth Edison Co., Chicago, Ill.). 1 Aug 1972. 2p. Dep. NTIS.

Information is presented concerning the malfunction of the stack monitoring system sample pump. (D.C.C.)

47357 (DOCKET-50237-253) DRESDEN NUCLEAR POWER STATION, UNIT 2. Diesel Generator Failed to Operate. (Commonwealth Edison Co., Chicago, Ill.). 1 Aug 1972. 4p. Dep. NTIS.

47358 (DOCKET-50237-254) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. QUAD-CITIES STATION, UNITS 1 AND 2. Operating History of the Rod Worth Minimizers. (Commonwealth Edison Co., Chicago, Ill.). 3 Aug 1972. 5p. (DOCKET-50249-149; DOCKET-50254-111; DOCKET-50265-98). Dep. NTIS.

47359 (DOCKET-50244-106) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Report of Exposure of an Individual to Radiation. (Directorate of Regulatory Operations (AEC), Washington, D. C.). 25 Jul 1972. 2p. Dep. NTIS.

47360 (DOCKET-50245-143) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence AO-72-18. (Millstone Point Co., Hartford, Conn.). 20 Jul 1972. 1p. Dep. NTIS.

Information is presented concerning the incorrect trip times for delay relays of the average power range monitoring system. (D.C.C.)

47361 (DOCKET-50245-146) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 1. Semiannual Report, January 1, 1972-June 30, 1972. (Millstone Point Co., Hartford, Conn.). 9 Aug 1972. 63p. Dep. NTIS.

47362 (DOCKET-50249-151) DRESDEN NUCLEAR POWER STATION, UNIT 3. During Monthly Surveillance Testing the Inboard Isolation Valve Failed to Close. (Commonwealth Edison Co., Chicago, Ill.). 10 Aug 1972. 2p. Dep. NTIS.

47363 (DOCKET-50254-105) QUAD-CITIES STATION, UNIT 1. Failure of RCIC Motor Operated Valve MO-1-1301-49 to Open on Signal. (Commonwealth Edison Co., Cordova, Ill.). 10 Jul 1972. 2p. Dep. NTIS.

47364 (DOCKET-50254-108) QUAD-CITIES STATION, UNITS 1 AND 2. Interim Report on Condenser Pump Room Modifications, Change. (Commonwealth Edison Co., Chicago, Ill.). 24 Jul 1972. 2p. (DOCKET-50265-93). Dep. NTIS.

47365 (DOCKET-50261-101) H. B. ROBINSON, UNIT 2. Malfunction of "B" Steam Line Isolation Valve. (Carolina Power and Light Co., Raleigh, N. C.). 18 Jul 1972. 1p. Dep. NTIS.

47366 (DOCKET-50261-102) H. B. ROBINSON UNIT 2. Boron Injection Tank Dilution. (Carolina Power and Light Co., Raleigh, N. C.). 24 Jul 1972. 1p. Dep. NTIS.

47367 (DOCKET-50263-137) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Turbine Trip at 100 percent Power and Subsequent Events. (Northern States Power Co., Minneapolis, Minn.). 20 Jul 1972. 7p. Dep. NTIS.

47368 (DOCKET-50263-139) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. High Pressure Coolant Injection System Failure. (Northern States Power Co., Minneapolis, Minn.). 27 Jul 1972. 2p. Dep. NTIS.

47369 (DOCKET-50263-140) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Malfunction of the "D" Steamline Safety/Relief Valve and Inoperability of Bellows Leakage

Monitoring Systems. (Northern States Power Co., Minneapolis, Minn.). 28 Jul 1972. 4p. Dep. NTIS.

47370 (DOCKET-50265-95) QUAD-CITIES STATION, UNIT 2. Fire in Two Electrical Cable Trays. (Commonwealth Edison Co., Cordova, Ill.). 24 Jul 1972. 6p. Dep. NTIS.

47371 (DOCKET-50265-96) QUAD-CITIES STATION, UNIT 2. Reactor Core Isolation Cooling System Inboard Steam Supply Valve Failed in Open Position. (Commonwealth Edison Co., Cordova, Ill.). 28 Jul 1972. 1p. Dep. NTIS.

47372 (DOCKET-50266-73) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. Boric Acid Concentration in "A" Boric Acid Storage Tank Below Technical Specifications Limit. (Wisconsin Electric Power Co., Milwaukee). 26 Jul 1972. 3p. (DOCKET-50301-65). Dep. NTIS.

47373 (DOCKET-50266-75) POINT BEACH NUCLEAR PLANT, UNIT 1. Steam Generator Cladding Repair. (Wisconsin Electric Power Co., Milwaukee). 19 Jul 1972. 58p. Dep. NTIS.

47374 (DOCKET-50271-90) VERMONT YANKEE NUCLEAR POWER STATION. License Application, Amendment 31. (Vermont Yankee Nuclear Power Corp., Rutland). 19 Jul 1972. 195p. Dep. NTIS.

Financial data on the owners of the Vermont Yankee Power Reactor are presented. The 1971 Annual Reports for the Central Vermont Public Service Corporation, Green Mountain Power Corporation, New England Power Company, Connecticut Light and Power Company, Central Maine Power Company, Public Service Company of New Hampshire, Hartford Electric Light Company, Cambridge Electric Light Company, Eastern Utilities Associates, and the Western Massachusetts Electric Company are included. (D.C.C.)

47375 (DOCKET-50277-51) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Amendment 17, Substitution of a New Exhibit "U." (Philadelphia Electric Co., Pa.). 14 Jul 1972. 4p. (Docket-50278-51). Dep. NTIS.

Additional information is presented concerning estimated operating and permanent shutdown costs. (D.C.C.)

47376 (DOCKET-50293-80) PILGRIM NUCLEAR POWER STATION. Abnormal Occurrence AO-72-3. (Boston Edison Co., Mass.). 6 Jul 1972. 3p. Dep. NTIS.

An unplanned actuation of isolation valves for the reactor core isolation cooling system is described. (D.C.C.)

47377 (DOCKET-50293-82) PILGRIM NUCLEAR POWER STATION. Abnormal Occurrence AO-72-4. (Boston Edison Co., Mass.). 17 Jul 1972. 3p. Dep. NTIS.

Incorrect operating procedures resulting in the inoperability of the reactor water cleanup system high flow isolation differential pressure switches are described. (D.C.C.)

47378 (DOCKET-50293-83) PILGRIM NUCLEAR POWER STATION. Abnormal Occurrence AO-72-5. (Boston Edison Co., Mass.). 24 Jul 1972. 3p. Dep. NTIS.

Information is presented concerning the unplanned restart of recirculation pumps during a loss of power startup test. (D.C.C.)

47379 (DOCKET-50304-59) ZION STATION NUCLEAR POWER PLANT, UNIT 2. Leaks in Canopies of Two Control Rod Drive Assemblies. (Directorate of Regulatory Operations (AEC), Washington, D. C.). 3 Aug 1972. 2p. Dep. NTIS.

47380 (DOCKET-50305-46) KEWAUNEE NUCLEAR POWER PLANT. Application for Construction Permit and Operating License, Amendment 20. (Wisconsin Public Service Corp., Green Bay). 18 Jul 1972. 5p. Dep. NTIS.

Additional information is presented concerning estimated operating and permanent shutdown costs. (D.C.C.)

47381 (DOCKET-50317-53) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Failure of Polar Crane Upper Limit Switch. (Directorate of Regulatory Operations (AEC), Washington, D. C.). 8 Aug 1972. 6p. (DOCKET-50318-51). Dep. NTIS.

47382 (DOCKET-50409-6) LA CROSSE BOILING WATER REACTOR. Incident Reports. (Dairyland Power Cooperative, La Crosse, Wis.). 20 Jul 1972. 9p. (DPC-72-5; DPC-72-6). Dep. NTIS.

Information is presented concerning revised bolting requirements for shutdown condenser partition, and fire in the forced circulation pump casing insulation. (D.C.C.)

47383 (DOCKET-50409-8) LA CROSSE BOILING WATER REACTOR. Incident Report, Hydrogen Detonation in Main Condenser Off-Gas System. (Dairyland Power Cooperative, La Crosse, Wis.). 2 Aug 1972. 5p. (DPC-72-7). Dep. NTIS.

47384 (DOCKET-50409-9) LA CROSSE BOILING WATER REACTOR. Monthly Operating Report, June 1972. (Dairyland Power Cooperative, La Crosse, Wis.). Jun 1972. Contract AT(11-1)-851. 31p. (DPC-851-44). Dep. NTIS.

47385 TRENDS IN CAPITAL COSTS OF GENERATING PLANTS. Roe, Kenneth A.; Young, William H. (Burns and Roe, Inc., New York). Power Eng.; 76: No. 6, 40-3(Jun 1972).

The rising trend of construction and capital costs for new electric power generating plants is examined. Some possible cost reduction solutions are discussed. (H.D.R.)

47386 ENVIRONMENTAL BENEFIT-COST ANALYSIS FOR NUCLEAR POWER GENERATION. Morrison, D. L. (Battelle Columbus Labs., Ohio); Males, R. H.; Duke, K. M.; Sharp, V. L.; Ritzman, R. L. Nucl. News; 15: No. 6, 50-7(Jun 1972).

The problems and procedures in preparing a cost-benefit analysis for nuclear power plants are discussed. The environmental considerations for the LaSalle County Station are used as an example of the practical limits and application of cost-benefit analyses to power reactors. (13 references) (H.D.R.)

47387 COMPARATIVE STUDY OF THE METHODOLOGY EMPLOYED IN ECONOMIC CALCULATIONS RELATING TO NUCLEAR POWER STATIONS IN THE SOVIET UNION AND WESTERN COUNTRIES. Koryakin, Yu. I. (Inst. of Atomic Energy, Moscow). At. Energy Rev.; 10: No. 2, 233-49(1972).

The methodological principles applied in Western countries and the Soviet Union in studying the economics of nuclear power stations are compared. It is shown that the mathematical formation to which these principles give rise coincides in many instances, although there are a number of differences in methodological approach, particularly as regards the use of mathematical operations, their conception and justification. 19 references. (auth)

Safety and Siting

Refer also to abstracts: 45535 and 45536.

47388 (DOCKET-50003-120) INDIAN POINT STATION, UNIT 1. Topical Report on General Electric Induction Motors: Inside Containment Low Pressure Core Cooling. (Consolidated Edison Co. of New York, Inc., New York). 3 Aug 1972. 177p. Dep. NTIS.

47389 (DOCKET-50010-113) DRESDEN NUCLEAR POWER STATION, UNIT 1. Proposed Change 17 to Operating License DPR-2. (Commonwealth Edison Co., Chicago, Ill.). 10 Jul 1972. 8p. Dep. NTIS.

The extent and consequences of hydrogen production in the containment of the Dresden Power Reactor, Unit 1 following a loss of coolant accident are evaluated. (H.D.R.)

47390 (DOCKET-50016-163) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Answer to Show Cause Order and Amendment to Request for Extension of Expiration Date of Provisional Operating License. (Power Reactor Development Co., Detroit, Mich.). 20 Jul 1972. 43p. Dep. NTIS.

47391 (DOCKET-50029-190) YANKEE NUCLEAR POWER STATION. Withdrawal of Proposed Change 101. (Yankee Atomic Electric Co., Westboro, Mass.). 31 Jul 1972. 1p. Dep. NTIS.

47392 (DOCKET-50133-89) HUMBOLDT BAY POWER PLANT, UNIT 3. Technical Specifications, Proposed Change 40. (Pacific Gas and Electric Co., San Francisco, Calif.). 19 Jul 1972. 13p. Dep. NTIS.

Revised technical specifications are presented concerning the design characteristics of Type 3 Batch 4 fuel assemblies. (D.C.C.)

47393 (DOCKET-50155-117) BIG ROCK POINT NUCLEAR PLANT. Technical Specification Change Request 31, Errata. (Consumers Power Co., Jackson, Mich.). 27 Jun 1972. 2p. Dep. NTIS.

An illustration of a Reload G fuel rod bundle is presented. (D.C.C)

47394 (DOCKET-50155-119) BIG ROCK POINT NUCLEAR PLANT. Technical Specifications, Proposed Change 33. (Consumers Power Co., Jackson, Mich.). 20 Jul 1972. 6p. Dep. NTIS.

Revised technical specifications are presented concerning test

requirements for the explosive valves of the liquid poison system. (D.C.C.)

47395 (DOCKET-50155-120) BIG ROCK POINT NUCLEAR PLANT. Technical Specifications, Proposed Change 34. (Consumers Power Co., Jackson, Mich.). 24 Jul 1972. 22p. Dep. NTIS.

Revised technical specifications are presented concerning the design characteristics of NFS-DA fuel bundles. (D.C.C.)

47396 (DOCKET-50213-150) HADDAM NECK PLANT, UNIT 1. Environmental Report, Appendix C, Addendum 2. (Connecticut Yankee Atomic Power Co., Hartford). 27 Jun 1972. 32p. Dep. NTIS.

The results of the Connecticut Yankee Power Reactor site environmental radiation survey program are presented for the period from July through December 1971. (H.D.R.)

47397 (DOCKET-50213-152) HADDAM NECK PLANT, UNIT 1. Environmental Report, Appendix E; Aquatic Benefit-cost. (Connecticut Yankee Atomic Power Co., Hartford). 27 Jun 1972. 77p. Dep. NTIS.

47398 (DOCKET-50219-200) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Final Safety Analysis Report, Amendment 70. (Jersey Central Power and Light Co., Morristown, N. J.). 19 Jul 1972. 31p. Dep. NTIS.

The final safety analysis report for the Oyster Creek Power Reactor Unit 1 is supplemented by the submission of requested additional data concerning maximum hurricane flood analysis. (D.C.C.)

47399 (DOCKET-50219-201) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Outside Radwaste Tank Activity. (Jersey Central Power and Light Co., Morristown, N. J.). 11 Jul 1972. 2p. Dep. NTIS.

47400 (DOCKET-50219-202) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Technical Specifications, Revised Pages Incorporating All Changes Through No. 12. (Jersey Central Power and Light Co., Morristown, N. J.). 1 Aug 1972. 38p. Dep. NTIS.

47401 (DOCKET-50220-98) NINE MILE POINT NUCLEAR STATION, UNIT 1. Environmental Report, Operating License Stage, Conversion to Full-Time Operating License. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 5 Jul 1972. 440p. Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. Ecological, geological, hydrological, and meteorological data for the reactor site are included. Cost-benefit analysis for reactor operations is presented. (D.C.C.)

47402 (DOCKET-50237-244) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. QUAD-CITIES STATION, UNITS 1 AND 2. Results of Inspection of Torus Section Headers. (Commonwealth Edison Co., Chicago, Ill.). 5 Jul 1972. 8p. (DOCKET-50249-141; DOCKET-50254-104; DOCKET-50265-91). Dep. NTIS.

47403 (DOCKET-50237-246) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Steps Taken to Correct Items of Apparent Noncompliance Called to Attention in Letter of June 19, 1972. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 19 Jun 1972. 6p. (DOCKET-50249-144). Dep. NTIS.

Additional information is presented concerning the use of the railroad interlock doors of the secondary containment system. (D.C.C.)

47404 (DOCKET-50237-249) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Environmental Report; Benefit-Cost Analysis Report. (Commonwealth Edison Co., Chicago, Ill.). 31 Jul 1972. 45p. (DOCKET-50249-147). Dep. NTIS.

The environmental report for the Dresden Power Reactor Units 2 and 3 is supplemented by the submission of cost-benefit analysis for alternate designs. (D.C.C.)

47405 (DOCKET-50237-255) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Technical Specifications, Proposed Change 18 (Unit 2); Technical Specifications, Change 9 (Unit 3). (Commonwealth Edison Co., Chicago, Ill.). 1 Aug 1972. 5p. (DOCKET-50249-150). Dep. NTIS.

Revised technical specifications are presented concerning the environmental radiation monitoring program. (D.C.C.)

47406 (DOCKET-50244-107) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Monthly Report of Activity Measurements. (Rochester Gas and Electric Corp., N. Y.). 3 Aug 1972. 2p. Dep. NTIS.

47407 (DOCKET-50245-139) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence AO-72-17. (Millstone Point Co., Hartford, Conn.). 14 Jul 1972. 1p. Dep. NTIS.

Information is presented concerning incorrect trip points for pressure vessel high pressure scram switches. (D.C.C.)

47408 (DOCKET-50245-140) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 1. Provisional Operating License DPR-21, Proposed Change 5. (Millstone Point Co., Hartford, Conn.). 12 Jul 1972. 9p. Dep. NTIS.

Additional information is presented concerning the 4.16 kV auxiliary bus system connection to the reserve station service transformer. (D.C.C.)

47409 (DOCKET-50245-141) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 1. Technical Specifications, Proposed Change 6. (Millstone Point Co., Hartford, Conn.). 12 Jul 1972. 24p. Dep. NTIS.

Revised technical specifications are presented concerning administrative controls and operating procedures. (D.C.C.)

47410 (DOCKET-50245-144) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 1. Technical Specifications, Proposed Change 8. (Millstone Point Co., Hartford, Conn.). 21 Jul 1972. 34p. Dep. NTIS.

Revised technical specifications are presented concerning the primary containment leak rate test requirements. (D.C.C.)

47411 (DOCKET-50245-145) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 1. Request Temporary Waiver of Technical Specification 3.5.F.6. (Millstone Point Co., Hartford, Conn.). 10 Aug 1972. 3p. Dep. NTIS.

Revised technical specifications are presented concerning maintenance procedures for the control rod drives. (D.C.C.)

47412 (DOCKET-50247-76) INDIAN POINT NUCLEAR GENERATING UNIT 2. Safety and Relief Valve Installation and Re-Analysis for ASME Class 1 and Class 2 Systems. (Consolidated Edison Co. of New York, Inc., New York). 13 Jul 1972. 22p. Dep. NTIS.

47413 (DOCKET-50250-84) TURKEY POINT PLANT, UNITS 3 AND 4. Final Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). Jul 1972. 368p. (DOCKET-50251-70). Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactors is presented. The effects of reactor operations on the environment are analyzed. Ecological, geological, hydrological, and meteorological data for the reactor site are included. Cost-benefit analysis for reactor operations is presented. (D.C.C.)

47414 (DOCKET-50250-85) TURKEY POINT PLANT, UNITS 3 AND 4. Facility Operating License DPR-31 With Appended Technical Specifications. (Directorate of Licensing (AEC), Washington, D. C.). 19 Jul 1972. 214p. (DOCKET-50251-71). Dep. NTIS.

47415 (DOCKET-50250-86) TURKEY POINT PLANT, UNITS 3 AND 4. Abnormal Occurrences 3-72-1 and 3-72-2. (Florida Power and Light Co.). 28 Jul 1972. 2p. (DOCKET-50251-73). Dep. NTIS.

During testing of the Turkey Point Power Reactor, Unit 3 under simulated safety injection conditions and loss of off-site power conditions the 4 kV busses failed to operate properly. Evaluations of the causes and consequences of these occurrences are presented. (H.D.R.)

47416 (DOCKET-50250-88) TURKEY POINT PLANT, UNITS 3 AND 4. Technical Specifications, Proposed Changes. (Florida Power and Light Co.). 11 Aug 1972. 4p. (DOCKET-50251-75). Dep. NTIS.

Revised technical specifications are presented concerning evaluation of power tilt limits. (D.C.C.)

47417 (DOCKET-50251-72) TURKEY POINT PLANT, UNIT 4. Structural Integrity Test Report and Containment Surveillance During the Structural Integrity Test. (Florida Power and Light Co.). 27 Jul 1972. 142p. Dep. NTIS.

47418 (DOCKET-50254-107) QUAD-CITIES STATION, UNITS 1 AND 2. Safety Analysis Report, Proposed Modification 72-1. (Commonwealth Edison Co., Chicago, Ill.). 20 Jul 1972. 12p. (DOCKET-50265-92). Dep. NTIS.

The safety analysis report for the Quad Cities Power Reactor Units 1 and 2 is supplemented by the submission of requested additional safety information. (D.C.C.)

47419 (DOCKET-50254–109) QUAD-CITIES STATION, UNITS 1 AND 2. Appendix A and Appendix B to DPR-29 and DPR-30, Proposed Change. (Commonwealth Edison Co., Chicago, Ill.). 25 Jul 1972. 110p. (DOCKET-50265–94). Dep. NTIS.

Revised and additional data are presented concerning technical specifications. (D.C.C.)

47420 (DOCKET-50254–110) QUAD-CITIES STATION, UNITS 1 AND 2. Final Report on Condenser Pump Room Modifications. (Commonwealth Edison Co., Chicago, Ill.). 31 Jul 1972. 8p. (DOCKET-50265–97). Dep. NTIS.

47421 (DOCKET-50254–112) QUAD-CITIES STATION, UNITS 1 AND 2. Operation of the Quad-Cities Diffuser Pipes. (Commonwealth Edison Co., Chicago, Ill.). 3 Aug 1972. 1p. (DOCKET-50265–99). Dep. NTIS.

47422 (DOCKET-50255–94) PALISADES PLANT. Application for Construction Permit and Operating License, Amendment 27. (Consumers Power Co., Jackson, Mich.). 14 Jul 1972. 2p. Dep. NTIS.

Additional information is presented concerning codes regulating the modifications for the radioactive waste disposal system. (D.C.C.)

47423 (DOCKET-50255–95) PALISADES PLANT. Technical Specifications, Request for Change 1. (Consumers Power Co., Jackson, Mich.). 14 Jul 1972. 13p. Dep. NTIS.

Revised technical specifications are presented concerning operating limits for the safety injection tanks. (D.C.C.)

47424 (DOCKET-50255–96) PALISADES PLANT. Environmental Impact of Plant Operation up to July 1, 1972. (Consumers Power Co., Jackson, Mich.). 19 Jul 1972. 360p. Dep. NTIS.

Information concerning radioactive and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. Ecological data for the reactor site are included. (D.C.C.)

47425 (DOCKET-50259–57) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Final Safety Analysis Report, Amendment 35. (Tennessee Valley Authority, Chattanooga). 14 Jul 1972. 22p. (DOCKET-50260–53; DOCKET-50296–50). Dep. NTIS.

The preliminary safety analysis report for the Browns Ferry Power Reactor Units 1, 2, and 3 is supplemented by the submission of requested information concerning reactor kinetics. (D.C.C.)

47426 (DOCKET-50259–58) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Final Safety Analysis Report, Amendment 36. (Tennessee Valley Authority, Chattanooga). 24 Jul 1972. 25p. (DOCKET-50260–54; DOCKET-50296–51). Dep. NTIS.

Revised and additional data are presented concerning the emergency electrical power systems for the reactors. (D.C.C.)

47427 (DOCKET-50259–59) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Final Safety Analysis Report, Amendment 37. (Tennessee Valley Authority, Chattanooga). 28 Jul 1972. 108p. (DOCKET-50260–55; DOCKET-50296–52). Dep. NTIS.

The final safety analysis report for the Browns Ferry Power Reactor, Units 1, 2, and 3 is amended by the submission of revised and additional information. (H.D.R.)

47428 (DOCKET-50259–60) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Final Safety Analysis Report, Amendment 38. (Tennessee Valley Authority, Chattanooga). 2 Aug 1972. 15p. (DOCKET-50260–56; DOCKET-50296–53). Dep. NTIS.

The final safety analysis report for the Browns Ferry Power Reactor, Units 1, 2, and 3 is amended by the submission of plant design changes. These changes incorporate charcoal filtering and pressurizing equipment in the main control room ventilation system and add physical barriers around the plant structures and service water pumps to provide protection from flooding. (H.D.R.)

47429 (DOCKET-50263–138) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Technical Specifications, Change Request 4. (Northern States Power Co., Minneapolis, Minn.). 24 Jul 1972. 5p. Dep. NTIS.

Revised technical specifications are presented concerning the residual heat removal service water pump head requirements. (D.C.C.)

47430 (DOCKET-50266–74) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. Discussion of Items of Apparent Noncompliance. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 3 Aug 1972. 10p. (DOCKET-50301–66). Dep. NTIS.

Additional information is presented concerning activities of the Off-Site Review Committee and radiation monitoring requirements. (D.C.C.)

47431 (DOCKET-50269–56) OCONEE NUCLEAR STATION, UNIT 1. Order Extending Provisional Construction Permit Completion Date. (Directorate of Licensing (AEC), Washington, D. C.). 27 Jun 1972. 2p. Dep. NTIS.

47432 (DOCKET-50269–60) OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3. Final Safety Analysis Report, Amendment 33. (Duke Power Co., Charlotte, N. C.). 26 Jul 1972. 224p. (DOCKET-50270–48; DOCKET-50287–43). Dep. NTIS.

The final safety analysis report for the Oconee Power Reactor Units 1, 2, and 3 is supplemented by the submission of revised and additional safety information. (D.C.C.)

47433 (DOCKET-50269–61) OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3. Steps Taken With Respect to Item Brought to Attention in Letter Dated April 21, 1972. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 3 Aug 1972. 3p. (DOCKET-50270–50; DOCKET-50287–45). Dep. NTIS.

The provisions for use of an audit task force within the Steam Production Department of the Oconee Power Reactor, Units, 1, 2, and 3 are described. (H.D.R.)

47434 (DOCKET-50270–49) OCONEE NUCLEAR STATION, UNITS 2 AND 3. Notice of Consideration of Issuance of Facility Operating Licenses and Notice of Opportunity for Hearing. (Directorate of Licensing (AEC), Washington, D. C.). 3 Aug 1972. 5p. (DOCKET-50287–44). Dep. NTIS.

47435 (DOCKET-50271–88) VERMONT YANKEE NUCLEAR POWER STATION. Final Environmental Statement. (Vermont Yankee Nuclear Power Corp., Rutland). Jul 1972. 357p. Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. Ecological, geological, hydrological, and meteorological data for the reactor site are included. Cost-benefit analysis for facility operations is presented. (D.C.C.)

47436 (DOCKET-50271–91) VERMONT YANKEE NUCLEAR POWER STATION. Technical Specifications, Proposed Change. (Vermont Yankee Nuclear Power Corp., Rutland). 6 Jul 1972. 7p. Dep. NTIS.

Revised technical specifications are presented concerning planned tests to be performed under the existing 1 percent low power license. (D.C.C.)

47437 (DOCKET-50271–92) VERMONT YANKEE NUCLEAR POWER STATION. Operating License DPR-28, Appendix B. (Vermont Yankee Nuclear Power Corp., Rutland). 7 Jul 1972. 26p. Dep. NTIS.

Technical specifications concerning chemical and thermal discharges from the reactor are presented. (D.C.C.)

47438 (DOCKET-50271–93) VERMONT YANKEE NUCLEAR POWER STATION. Changes in Steam Tunnel Ventilation System. (Vermont Yankee Nuclear Power Corp., Rutland). 25 Jul 1972. 4p. Dep. NTIS.

47439 (DOCKET-50271–94) VERMONT YANKEE NUCLEAR POWER STATION. Technical Specifications, Change 1. (Directorate of Licensing (AEC), Washington, D. C.). 24 Jul 1972. 3p. Dep. NTIS.

Revised technical specifications are presented concerning bypass conditions for protection system scrams. (D.C.C.)

47440 (DOCKET-50271–95) VERMONT YANKEE NUCLEAR POWER STATION. Technical Specifications, Proposed Change 1, Supplement 1. (Vermont Yankee Nuclear Power Corp., Rutland). 25 Jul 1972. 18p. Dep. NTIS.

Revised technical specifications are presented concerning the off gas radioactive waste processing system. (D.C.C.)

47441 (DOCKET-50272–29) SALEM NUCLEAR GENERATING STATION, UNITS 1 AND 2. Final Safety Analysis Re-

port, Amendment 12. (Public Service Electric and Gas Co., Newark, N. J.). 31 Jul 1972. 173p. (DOCKET-50311-29). Dep. NTIS.

The final safety analysis report for the Salem Power Reactor, Units 1 and 2 is amended by the submission of revised and requested additional information. (H.D.R.)

47442 (DOCKET-50272-30) SALEM NUCLEAR GENERATING STATION, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 13. (Public Service Electric and Gas Co., Newark, N. J.). 2 Jun 1972. 154p. (DOCKET-50311-30). Dep. NTIS.

The final safety analysis report for the Salem Power Reactor, Units 1 and 2 is amended by the submission of requested additional information. (H.D.R.)

47443 (DOCKET-50272-31) SALEM NUCLEAR GENERATING STATION, UNITS 1 AND 2. Final Safety Analysis Report, Volume 6. (Public Service Electric and Gas Co., Newark, N. J.). 7 Aug 1972. 109p. (DOCKET-50311-31). Dep. NTIS.

The final safety analysis report for the Salem Power Reactor, Units 1 and 2 is supplemented by the responses to specific questions. (H.D.R.)

47444 (DOCKET-50272-32) SALEM NUCLEAR GENERATING STATION, UNITS 1 AND 2. Final Safety Analysis Report, Volume 7. (Public Service Electric and Gas Co., Newark, N. J.). 7 Aug 1972. 213p. (DOCKET-50311-32). Dep. NTIS.

The final safety analysis report for the Salem Power Reactor, Units 1 and 2 is supplemented by the responses to specific questions. (H.D.R.)

47445 (DOCKET-50272-33) SALEM NUCLEAR GENERATING STATION, UNITS 1 AND 2. Environmental Report, Amendment 2. (Public Service Electric and Gas Co., Newark, N. J.). 9 Aug 1972. 206p. (DOCKET-50311-33). Dep. NTIS.

47446 (DOCKET-50275-22) DIABLO CANYON NUCLEAR POWER PLANT, UNITS 1 AND 2. Environmental Report, Supplement 2, Volume 1. (Pacific Gas and Electric Co., San Francisco, Calif.). 28 Jul 1972. 484p. (DOCKET-50323-20). Dep. NTIS.

The environmental report for the Diablo Canyon Power Reactor Units 1 and 2 is supplemented by the submission of revised and additional information for the facility. (D.C.C.)

47447 (DOCKET-50275-23) DIABLO CANYON NUCLEAR POWER PLANT, UNITS 1 AND 2. Environmental Report, Supplement 2, Volume 2. (Pacific Gas and Electric Co., San Francisco, Calif.). Jul 1972. 716p. (DOCKET-50323-21). Dep. NTIS.

47448 (DOCKET-50277-52) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Environmental Report, Operating License Stage, Supplement 5. (Philadelphia Electric Co., Pa.). 28 Jul 1972. 11p. (DOCKET-50278-52). Dep. NTIS.

Requested additional information is presented concerning transmission lines, chemical effluents, and thermal effluents. (D.C.C.)

47449 (DOCKET-50280-77) SURRY POWER STATION, UNITS 1 AND 2. Topical Report on General Electric Vertical Induction Motors, Inside Containment Recirculation Spray Pump Motors, Addendum. (Virginia Electric and Power Co., Richmond). 14 Jul 1972. 48p. (DOCKET-50281-75). Dep. NTIS.

47450 (DOCKET-50282-59) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1. Application for AEC Class 104b Operating License, Amendment 13. (Northern States Power Co., Minneapolis, Minn.). 30 Dec 1971. 3p. Dep. NTIS.

A request is presented for extension of the date for completion of the Prairie Island Power Reactor, Unit 1 to February 1, 1973. (H.D.R.)

47451 (DOCKET-50282-67) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 19. (Northern States Power Co., Minneapolis, Minn.). 14 Jul 1972. 713p. (DOCKET-50306-64). Dep. NTIS.

The final safety analysis report for the Prairie Island Power Reactor Units 1 and 2 is supplemented by the submission of revised and additional safety information. (D.C.C.)

47452 (DOCKET-50282-68) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Report of Corrosion Problem in Refueling Water Storage Tanks. (Directorate of Regulatory Operations (AEC), Washington, D. C.). 20 Jul 1972. 4p. (DOCKET-50306-65). Dep. NTIS.

47453 (DOCKET-50282-69) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 20. (Northern States Power Co., Minneapolis, Minn.). 4 Aug 1972. 252p. (DOCKET-50306-66). Dep. NTIS.

The final safety analysis report for the Prairie Island Power Reactor Units 1 and 2 is amended by the submission of revised and requested safety information. (D.C.C.)

47454 (DOCKET-50285-68) FORT CALHOUN STATION, UNIT 1. Safety Evaluation. (Directorate of Licensing (AEC), Washington, D. C.). 14 Aug 1972. 99p. Dep. NTIS.

47455 (DOCKET-50286-46) INDIAN POINT NUCLEAR GENERATING UNIT 3. Final Facility Description and Safety Analysis Report, Amendment 18, Supplement 4. (Consolidated Edison Co. of New York, Inc., New York). 30 Jun 1972. 36p. Dep. NTIS.

The final safety analysis report for the Indian Point Power Reactor, Unit 3 is amended by the submission of revised and requested additional information. (H.D.R.)

47456 (DOCKET-50286-47) INDIAN POINT NUCLEAR GENERATING UNIT 3. Final Safety Analysis Report, Supplement 5. (Consolidated Edison Co. of New York, Inc., New York). 20 Jul 1972. 51p. Dep. NTIS.

The final safety analysis report for the Indian Point Power Reactor Unit 3 is supplemented by the submission of requested additional information. (D.C.C.)

47457 (DOCKET-50286-48) INDIAN POINT NUCLEAR GENERATING UNIT 3. Final Facility Description and Safety Analysis Report, Supplement 6. (Consolidated Edison Co. of New York, Inc., New York). 1 Aug 1972. 104p. Dep. NTIS.

The final safety analysis report for the Indian Point Power Reactor, Unit 3 is supplemented by the submission of revised and requested additional information. (HD.R.)

47458 (DOCKET-50286-49) INDIAN POINT NUCLEAR GENERATING UNIT 3. Final Facility Description and Safety Analysis Report, Supplement 7. (Consolidated Edison Co. of New York, Inc., New York). 1 Aug 1972. 400p. Dep. NTIS.

The final safety analysis report for the Indian Point Power Reactor Unit 3 is supplemented by the submission of requested additional safety information. (D.C.C.)

47459 (DOCKET-50289-61) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Action Taken to Correct Item of Nonconformance Found on May 4, 1972 Inspection. (Division of Compliance (AEC), Newark, N. J. Region I). 28 Jun 1972. 4p. Dep. NTIS.

Additional information is presented concerning the construction of the containment structure ring girder. (D.C.C.)

47460 (DOCKET-50289-62) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Report of Significant Deficiency/Thin Walled Valves. (Directorate of Regulatory Operations (AEC), Washington, D. C.). 11 Jul 1972. 4p. Dep. NTIS.

47461 (DOCKET-50289-63) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Final Safety Analysis Report, Amendment 27. (Metropolitan Edison Co., Reading, Pa.). 14 Aug 1972. 136p. Dep. NTIS.

The final safety analysis report for the Three Mile Island Power Reactor Unit 1 is amended by the submission of revised and additional safety information. (D.C.C.)

47462 (DOCKET-50295-57) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Steps Taken to Correct Items of Apparent Noncompliance in Letter of June 12, 1972. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 25 Jul 1972. 10p. (DOCKET-50304-56). Dep. NTIS.

Additional information is presented concerning welding procedures, the quality assurance requirements for the main steam isolation valve, and qualifications for nondestructive testing personnel. (D.C.C.)

47463 (DOCKET-50295-58) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Accident Report, April 24, 1972. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 25 Jul 1972. 8p. (DOCKET-50304-57). Dep. NTIS.

Information is presented concerning reactor components involved in a warehouse fire at the construction site. (D.C.C.)

47464 (DOCKET-50295-59) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Steps Taken to Correct Items of Apparent Noncompliance Brought to Attention in Letter Dated June 23, 1972. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 9 Aug 1972. 7p. (DOCKET-50304-58). Dep. NTIS.

Additional information is presented concerning the installation and inspection of instrumentation and electric cables. (D.C.C.)

47465 (DOCKET-50298-43) COOPER NUCLEAR STATION. Environmental Report, Supplement 2. (Nebraska Public Power District, Columbus). 26 Jun 1972. 46p. Dep. NTIS.

The environmental report for the Cooper Power Reactor is supplemented by the submission of requested additional data. (D.C.C.)

47466 (DOCKET-50298-46) COOPER NUCLEAR STATION. Final Safety Analysis Report, Amendment 13. (Nebraska Public Power District, Columbus). 18 Jul 1972. 256p. Dep. NTIS.

The final safety analysis report for the Cooper Power Reactor is supplemented by the submission of requested additional safety information. (D.C.C.)

47467 (DOCKET-50298-47) COOPER NUCLEAR STATION. Final Safety Analysis Report, Amendment 11. (Nebraska Public Power District, Columbus). 24 Jul 1972. 8p. Dep. NTIS.

Facility modifications are described for the spent fuel storage pool, the reactor building closed cooling water system, fire protection system failure, and battery ventilation system. (D.C.C.)

47468 (DOCKET-50298-48) COOPER NUCLEAR STATION Environmental Report, Supplement 3. (Nebraska Public Power District, Columbus). 4 Aug 1972. 41p. Dep. NTIS.

47469 (DOCKET-50301-64) POINT BEACH NUCLEAR PLANT, UNIT 2. Facility Operating License No. DPR-27, Amendment 2. (Directorate of Licensing (AEC), Washington, D. C.). 28 Jul 1972. 11p. Dep. NTIS.

47470 (DOCKET-50305-44) KEWAUNEE NUCLEAR POWER PLANT. Final Safety Analysis Report, Amendment 19. (Wisconsin Public Service Corp., Green Bay). 30 Jun 1972. 197p. Dep. NTIS.

The final safety analysis report for the Kewaunee Power Reactor is supplemented by the submission of revised and additional safety information. (D.C.C.)

47471 (DOCKET-50305-45) KEWAUNEE NUCLEAR POWER PLANT. Draft Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). Jul 1972. 249p. Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. Ecological, geological, hydrological, and meteorological data for the reactor site are included. Cost-benefit analysis for reactor operation is presented. (D.C.C.)

47472 (DOCKET-50305-47) KEWAUNEE NUCLEAR POWER PLANT. Steps Taken to Correct Item of Apparent Noncompliance Noted in Letter Dated July 17, 1972. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 8 Aug 1972. 6p. Dep. NTIS.

Additional information is presented concerning the installation of Class 1 instrument controllers which did not meet quality control requirements. (D.C.C.)

47473 (DOCKET-50309-61) MAINE YANKEE ATOMIC POWER STATION. Final Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). Jul 1972. 231p. Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. Ecological geological, hydrological, and meteorological data for the reactor site are included. Cost-benefit analysis for reactor operations is presented. (D.C.C.)

47474 (DOCKET-50309-62) MAINE YANKEE ATOMIC POWER STATION. Final Safety Analysis Report, Amendment 35. (Maine Yankee Atomic Power Co., Westboro, Mass.). 27 Jul 1972. 96p. Dep. NTIS.

The final safety analysis report for the Maine Yankee Power Reactor is supplemented by the submission of revised and additional safety information. (D.C.C.)

47475 (DOCKET-50309-63) MAINE YANKEE ATOMIC POWER STATION. Environmental Qualification of Vital Instrumentation and Electrical Cables, and Penetration Connectors. (Maine Yankee Atomic Power Co., Westboro, Mass.). 27 Jul 1972. 66p. Dep. NTIS.

47476 (DOCKET-50309-64) MAINE YANKEE ATOMIC POWER STATION. Seismic Design Review. (Maine Yankee Atomic Power Co., Wiscasset). 27 Jul 1972. 113p. Dep. NTIS.

47477 (DOCKET-50309-65) MAINE YANKEE ATOMIC POWER STATION. Seismic Qualification of Vital Instrument and Electrical Equipment. (Maine Yankee Atomic Power Co., Westboro, Mass.). 27 Jul 1972. 391p. Dep. NTIS.

47478 (DOCKET-50309-66) MAINE YANKEE ATOMIC POWER STATION. Final Safety Analysis Report, Amendment 36. (Maine Yankee Atomic Power Co., Westboro, Mass.). 10 Aug 1972. 33p. Dep. NTIS.

Revised information is presented concerning LOCA analysis for the Maine Yankee Power Reactor. (D.C.C.)

47479 (DOCKET-50312-41) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Environmental Report, Amendment 2. (Sacramento Municipal Utility District, Calif.). 30 Jun 1972. 196p. Dep. NTIS.

The environmental report for the Rancho Seco Power Reactor is supplemented by the submission of revised and additional information for the facility. (D.C.C.)

47480 (DOCKET-50312-42) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Final Safety Analysis Report, Amendment 12. (Sacramento Municipal Utility District, Calif.). 26 Jun 1972. 497p. Dep. NTIS.

The final safety analysis report for the Rancho Seco Power Reactor, Unit 1 is amended by the submission of revised and requested additional information. (H.D.R.)

47481 (DOCKET-50312-43) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Report on Minor Imperfections Found in Pipe Welds. (Sacramento Municipal Utility District, Calif.). 30 May 1972. 39p. Dep. NTIS.

47482 (DOCKET-50312-45) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Final Safety Analysis Report, Amendment 13. (Sacramento Municipal Utility District, Calif.). 19 Jul 1972. 43p. Dep. NTIS.

The final safety analysis report for the Rancho Seco Power Reactor is supplemented by the submission of requested additional safety information. (D.C.C.)

47483 (DOCKET-50312-46) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Weld Defects Found in Steam Generator Lateral Support. (Sacramento Municipal Utility District, Calif.). 24 Jul 1972. 17p. Dep. NTIS.

47484 (DOCKET-50312-47) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Report on Minor Imperfections Found in Pipe Welds. (Directorate of Regulatory Operations (AEC), Washington, D. C.). 20 Jul 1972. 39p. Dep. NTIS.

47485 (DOCKET-50312-48) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Weld Defects Found in Steam Generator Lateral Support. (Directorate of Regulatory Operations (AEC), Washington, D. C.). 4 Aug 1972. 19p. Dep. NTIS.

47486 (DOCKET-50313-44) ARKANSAS NUCLEAR ONE, UNIT 1. Environmental Report, Supplement 2. (Arkansas Power and Light Co., Little Rock). 28 Jun 1972. 44p. Dep. NTIS.

The environmental report for the Arkansas Nuclear One Power Reactor is supplemented by the submission of cost-benefit data for alternate designs for the facility. (D.C.C.)

47487 (DOCKET-50313-45) ARKANSAS NUCLEAR ONE, UNIT 1. Environmental Report, Supplement 3. (Arkansas Power and Light Co., Little Rock). 25 Jul 1972. 91p. Dep. NTIS.

The environmental report for the Arkansas Nuclear One Power Reactor is supplemented by the submission of revised and additional information for the facility. (D.C.C.)

47488 (DOCKET-50313-46) ARKANSAS NUCLEAR ONE, UNIT 1. Final Safety Analysis Report, Amendment 27. (Arkansas Power and Light Co., Little Rock). 4 Aug 1972. 167p. Dep. NTIS.

The final safety analysis report for the Arkansas Nuclear One Power Reactor is supplemented by the submission of revised and requested safety information. (D.C.C.)

47489 (DOCKET-50315-65) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Environmental Report, Supplement 3. (Indiana and Michigan Power Co., New York). 27 Jun 1972. 30p. (DOCKET-50316-65). Dep. NTIS.

The environmental report for the Donald C. Cook Power

Reactor Units 1 and 2 is supplemented by the submission of additional information on cost-benefit analysis for alternate designs. (D.C.C.)

47490 (DOCKET-50315-68) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 25. (Indiana and Michigan Power Co., New York). 21 Jul 1972. 176p. (DOCKET-50316-68). Dep. NTIS.

The final safety analysis report for the Donald C. Cook Power Reactor, Units 1 and 2 is amended by the submission of revised and requested additional information. (H.D.R.)

47491 (DOCKET-50315-69) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Defective Welding on Ice Condenser System Positioning Frames. (Directorate of Regulatory Operations (AEC), Washington, D. C.). 31 Jul 1972. 5p. (DOCKET-50316-69). Dep. NTIS.

47492 (DOCKET-50315-70) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Deficiency in Radiography Techniques. (Directorate of Regulatory Operations (AEC), Washington, D. C.). 14 Jul 1972. 7p. (DOCKET-50316-70). Dep. NTIS.

47493 (DOCKET-50315-71) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 26. (Indiana and Michigan Power Co., New York). 7 Aug 1972. 13p. (DOCKET-50316-71). Dep. NTIS.

Information is presented concerning the long term pressure transient in the containment structure following a LOCA. (D.C.C.)

47494 (DOCKET-50321-46) EDWIN I. HATCH NUCLEAR PLANT, UNIT 1. Final Safety Analysis Report, Amendment 17. (Georgia Power Co., Atlanta). 26 Jun 1972. 119p. Dep. NTIS.

Requested additional information is presented concerning containment systems and auxiliary equipment. Stress analysis for the pressure vessel is included. (D.C.C.)

47495 (DOCKET-50321-48) EDWIN I. HATCH NUCLEAR PLANT, UNIT 1. Steps Taken to Correct Items of Apparent Noncompliance Which Were Brought to Attention in Letter of July 5, 1972. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 3 Aug 1972. 8p. Dep. NTIS.

Requested information is presented concerning quality assurance requirements for construction, welding procedures, and storage requirements for Class 1 equipment. (D.C.C.)

47496 (DOCKET-50324-39) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Expected Doses Which Might Result From Purging Containment. (Carolina Power and Light Co., Raleigh, N. C.). 31 Jul 1972. 3p. (DOCKET-50325-40). Dep. NTIS.

47497 (DOCKET-50324-40) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Environmental Report, Amendment 2. (Carolina Power and Light Co., Raleigh, N. C.). 14 Aug 1972. 111p. (DOCKET-50325-41). Dep. NTIS.

The environmental report for the Brunswick Power Reactor Units 1 and 2 is amended by the submission of revised cost-benefit information. (D.C.C.)

47498 (DOCKET-50331-48) DUANE ARNOLD ENERGY CENTER. Environmental Report Revised, Amendment 1. (Iowa Electric Light and Power Co., Cedar Rapids). 6 Jul 1972. 93p. Dep. NTIS.

The environmental report for the Duane Arnold Power Reactor is supplemented by the submission of cost-benefit data for alternate design for the facility. (D.C.C.)

47499 (DOCKET-50331-49) DUANE ARNOLD ENERGY CENTER. Final Safety Analysis Report, Amendment 2. (Iowa Electric Light and Power Co., Cedar Rapids). 10 Jul 1972. 518p. Dep. NTIS.

The final safety analysis report for the Duane Arnold Power Reactor is amended by the submission of revised and requested additional information. (H.D.R.)

47500 (DOCKET-50331-51) DUANE ARNOLD ENERGY CENTER. Final Safety Analysis Report, Amendment 3. (Iowa Electric Light and Power Co., Cedar Rapids). Jul 1972. 172p. Dep. NTIS.

The final safety analysis report for the Duane Arnold Power Reactor is amended by the submission of revised and requested additional information. (H.D.R.)

47501 (DOCKET-50333-50) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Final Facility Description and Safety Analysis Report, Supplement 9. (Power Authority of the State of New York). 7 Aug 1972. 172p. Dep. NTIS.

The final safety analysis report for the James A. Fitzpatrick Power Reactor is supplemented by the submission of requested additional safety information. (D.C.C.)

47502 (DOCKET-50333-51) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Environmental Report, Supplement 3. (Power Authority of the State of New York). 11 Aug 1972. 22p. Dep. NTIS.

The environmental report for the James A. Fitzpatrick Power Reactor is supplemented by the submission of requested additional information for the facility. (D.C.C.)

47503 (DOCKET-50334-31) BEAVER VALLEY POWER STATION, UNIT 1. Action Taken to Correct Items of Nonconformance and Noncompliance Found on Inspection of April 18-20, 1972. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 10 Jul 1972. 8p. Dep. NTIS.

Additional information is presented concerning the quality assurance requirements for sampling and testing concrete, electrical wiring installation procedures, and storage requirements for electrical equipment. (D.C.C.)

47504 (DOCKET-50335-29) HUTCHINSON ISLAND PLANT, UNIT 1. Environmental Report, Supplement 5. (Florida Power and Light Co.). 28 Jun 1972. 34p. Dep. NTIS.

The environmental report for the Hutchinson Island Power Reactor, Unit 1 is supplemented by the submission of cost-benefit information for the facility. (H.D.R.)

47505 (DOCKET-50335-30) HUTCHINSON ISLAND PLANT, UNIT 1. Environmental Report, Supplement 6. (Florida Power and Light Co.). 6 Jul 1972. 17p. Dep. NTIS.

The alternatives are analyzed for the proposed transmission line crossings of the Indian River near the Hutchinson Island Power Reactor, Unit 1. (H.D.R.)

47506 (DOCKET-50335-32) HUTCHINSON ISLAND PLANT, UNIT 1. Environmental Report, Supplement 7. (Florida Power and Light Co.). 14 Jul 1972. 11p. Dep. NTIS.

Requested additional information is presented concerning the construction of the circulating water system intake and discharge pipelines. (D.C.C.)

47507 (DOCKET-50336-35) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 2. Operating License Application. (Millstone Point Co., Hartford, Conn.). 15 Aug 1972. 55p. Dep. NTIS.

Financial data on the owners of the Millstone Point Power Reactor Unit 2 are presented. (D.C.C.)

47508 (DOCKET-50336-36) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 2. Final Safety Analysis Report, Volume 1. (Millstone Point Co., Hartford, Conn.). 10 Aug 1972. 802p. Dep. NTIS.

Information on the Millstone Point Power Reactor Unit 2 is presented under the following broad topics: AEC general design criteria; quality assurance program; site characteristics; reactor kinetics; stress analysis for pressure vessel internals; cooling system; and structures. (D.C.C.)

47509 (DOCKET-50336-37) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 2. Final Safety Analysis Report, Volume 2. (Millstone Point Co., Hartford, Conn.). 1972. 720p. Dep. NTIS.

Information on the Millstone Point Power Reactor Unit 2 is presented under the following broad topics: engineered safeguards; instrumentation; control systems; and electrical systems. (D.C.C.)

47510 (DOCKET-50338-47) NORTH ANNA POWER STATION, UNITS 1, 2, 3, AND 4. Environmental Report Supplement, Revision 2. (Virginia Electric and Power Co., Richmond). 23 Jun 1972. 42p. (DOCKET-50339-44; DOCKET-50404-17; DOCKET-50405-17). Dep. NTIS.

The environmental report for the North Anna Power Reactor Units 1, 2, 3, and 4 is supplemented by the submission of cost-benefit analysis for design alternatives for the facility. (D.C.C.)

47511 (DOCKET-50338-48) NORTH ANNA POWER STATION, UNITS 1 AND 2. Environmental Considerations. (Virginia Electric and Power Co., Richmond). 29 Sep 1970. 187p. (DOCKET-50339-45). Dep. NTIS.

The effects of impoundment of the North Anna River by the dam and the effects of Units 1 and 2 of the North Anna Power Reactor on the impoundment are discussed. (H.D.R.)

47512 (DOCKET-50338-49) NORTH ANNA POWER STATION, UNITS 1 AND 2. Request for Permission to Resume Work on Transmission Line. (Virginia Electric and Power

Co., Richmond). 1 Aug 1972. 3p. (DOCKET-50339-46). Dep. NTIS.

47513 (DOCKET-50341-42) ENRICO FERMI ATOMIC POWER PLANT, UNIT 2. Cracks in the Basement Floor Slab of the Reactor Building. (Detroit Edison Co., Mich.). 2 Jun 1972. 3p. Dep. NTIS.

47514 (DOCKET-50341-43) ENRICO FERMI ATOMIC POWER PLANT, UNIT 2. Deformation of Containment Drywell. (Directorate of Regulatory Operations (AEC), Washington, D. C.). 17 Jul 1972. 12p. Dep. NTIS.

47515 (DOCKET-50344-29) TROJAN NUCLEAR PLANT. Initial Decision on Environmental Review. (Portland General Electric Co., Oreg.). 23 May 1972. 27p. Dep. NTIS.

The factors considered in the Atomic Safety and Licensing Board decision to allow Trojan Power Reactor construction activities to continue pending completion of the environmental review are presented. (H.D.R.)

47516 (DOCKET-50344-30) TROJAN NUCLEAR PLANT. Supplemental Environmental Report, Amendment 3. (Portland General Electric Co., Oreg.). 24 Jul 1972. 50p. Dep. NTIS.

The environmental report for the Trojan Power Reactor Unit 1 is supplemented by the submission of revised and additional information for the facility. (D.C.C.)

47517 (DOCKET-50346-27) DAVIS-BESSE NUCLEAR POWER STATION. Steps Taken to Correct Items of Apparent Nonconformance Noted in Letter Dated May 22, 1972. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 22 Jun 1972. 5p. Dep. NTIS.

Additional information is presented concerning corrected inspection and certification procedures for component cooling and service water piping. (D.C.C.)

47518 (DOCKET-50346-29) DAVIS-BESSE NUCLEAR POWER STATION. Environmental Report, Supplement, Amendment 1. (Toledo Edison Co., Ohio). 14 Jul 1972. 74p. Dep. NTIS.

The environmental report for the Davis-Besse Power Reactor is supplemented by the submission of revised and additional information for the facility. (D.C.C.)

47519 (DOCKET-50348-42) JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2. Steps Taken to Correct Items of Apparent Noncompliance Brought to Attention in Letter Dated June 21, 1972. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 3 Aug 1972. 13p. (DOCKET-50364-36). Dep. NTIS.

Actions taken to correct activities in vendor shop inspection of welds and in inspection of concrete placement for the Joseph M. Farley Power Reactor, Units 1 and 2 are described. (H.D.R.)

47520 (DOCKET-50352-27) LIMERICK GENERATING STATION, UNITS 1 AND 2. Environmental Report, Construction Permit Stage (Revised), Supplement 1. (Philadelphia Electric Co., Pa.). 11 Aug 1972. 56p. (DOCKET-50353-27). Dep. NTIS.

The environmental report for Limerick Power Reactor, Units 1 and 2 is supplemented by the submission of responses to requests for additional information. (H.D.R.)

47521 (DOCKET-50354-25) NEWBOLD ISLAND NUCLEAR GENERATING STATION, Unit 1. Inspection of Reactor Pressure Vessel Fabrication at Hitachi, Ltd. (Directorate of Regulatory Operations (AEC), Washington, D. C.). 10 Jul 1972. 11p. Dep. NTIS.

47522 (DOCKET-50361-25) SAN ONOFRE NUCLEAR GENERATING STATION, UNITS 2 AND 3. Application for a Construction Pemit and a Class 104(b) License, Amendment 15. (Southern California Edison Co., Rosemead, Calif.). 30 Jun 1972. 179p. (DOCKET-50362-24). Dep. NTIS.

Financial data on the owners of the San Onofre Power Reactor Units 2 and 3 are presented. The 1971 Annual Reports for the Southern California Edison Company and the San Diego Gas and Electric Company are included. (D.C.C.)

47523 (DOCKET-50361-26) SAN ONOFRE NUCLEAR GENERATING STATION, UNITS 2 AND 3. Preliminary Safety Analysis Report, Amendment 14. (Southern California Edison Co., Rosemead, Calif.). 29 Jun 1972. 285p. (DOCKET-50362-25). Dep. NTIS.

The preliminary safety analysis report for the San Onofre Power Reactor, Units 2 and 3 is amended by the submission of revised and requested additional information. (H.D.R.)

47524 (DOCKET-50363-30) FORKED RIVER NUCLEAR GENERATING STATION, UNIT 1. Preliminary Safety Analysis Report, Amendment 19. (Jersey Central Power and Light Co., Morristown, N. J.). 15 Jul 1972. 74p. Dep. NTIS.

The preliminary safety analysis report for the Forked River Power Reactor Unit 1 is supplemented by the submission of revised and additional safety information. (D.C.C.)

47525 (DOCKET-50363-31) FORKED RIVER NUCLEAR GENERATING STATION, UNIT 1. Preliminary Safety Analysis Report, Amendment 20. (Jersey Central Power and Light Co., Morristown, N. J.). 31 Jul 1972. 50p. Dep. NTIS.

The preliminary safety analysis report for the Forked River Power Reactor, Unit 1 is amended by the submission of revised data. (H.D.R.)

47526 (DOCKET-50363-32) FORKED RIVER NUCLEAR GENERATING STATION, UNIT 1. Environmental Report, Correction of Cost-Benefit Analysis. (Jersey Central Power and Light Co., Morristown, N. J.). 2 Aug 1972. 1p. Dep. NTIS.

47527 (DOCKET-50363-34) FORKED RIVER NUCLEAR GENERATING STATION, UNIT 1. Environmental Report, Commercial Fishing in Barnegat Bay. (Jersey Central Power and Light Co., Morristown, N. J.). 8 Aug 1972. 3p. Dep. NTIS.

47528 (DOCKET-50366-29) EDWIN I. HATCH NUCLEAR PLANT, UNIT 2. Preliminary Safety Analysis Report, Amendment 16. (Georgia Power Co., Atlanta). 23 Jun 1972. 12p. Dep. NTIS.

Additional data are presented concerning design parameters of the pressure vessel pedestal. (D.C.C.)

47529 (DOCKET-50366-31) EDWIN I. HATCH NUCLEAR PLANT, UNIT 2. Safety Evaluation. (Directorate of Licensing (AEC), Washington, D. C.). 21 Jul 1972. 182p. Dep. NTIS.

47530 (DOCKET-50366-32) EDWIN I. HATCH NUCLEAR PLANT, UNIT 2. Department of Justice Opinion With Respect to Monopoly. (Department of Justice, Washington, D. C. Antitrust Div.). 2 Aug 1972. 12p. Dep. NTIS.

47531 (DOCKET-50366-33) EDWIN I. HATCH NUCLEAR PLANT, UNIT 2. Steps Taken to Correct Items of Apparent Noncompliance Brought to Attention in Letter Dated June 28, 1972. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 3 Aug 1972. 6p. Dep. NTIS.

Requested information is presented concerning design change notices and quality assurance requirements. (D.C.C.)

47532 (DOCKET-50368-31) ARKANSAS NUCLEAR ONE, UNIT 2. Draft Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). Jul 1972. 210p. Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. Ecological, geological, hydrological, and meteorological data for the reactor site are included. Cost-benefit analysis for reactor operations is presented. (D.C.C.)

47533 (DOCKET-50369-26) McGUIRE NUCLEAR STATION, UNITS 1 AND 2. Application for Licenses, Amendment 12. (Duke Power Co., Charlotte, N. C.). 18 Oct 1971. 7p. (DOCKET-50370-26). Dep. NTIS.

Cost data and a forecast of construction expenditures for the McGuire Power Reactor, Units 1 and 2 are presented. (H.D.R.)

47534 (DOCKET-50369-28) McGUIRE NUCLEAR STATION, UNITS 1 AND 2. Draft Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). Jul 1972. 302p. (DOCKET-50370-28). Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactors is presented. The effects of reactor operations on the environment are analyzed. Ecological, geological, hydrological, and meteorological data for the reactor site are included. Cost-benefit analysis for reactor operations is presented. (D.C.C.)

47535 (DOCKET-50373-24) LA SALLE COUNTY STATION, UNITS 1 AND 2. Draft Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). Jul 1972. 133p. (DOCKET-50374-23). Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactors is presented. The effects of reactor operations on the environment are analyzed. Ecological, geological, hydrological, and meteorological data for the reactor site are included. Cost-benefit analysis for reactor operations is presented. (D.C.C.)

47536 (DOCKET-50373-25) LA SALLE COUNTY STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 10. (Commonwealth Edison Co., Chicago, Ill.). 26 Jul 1972. 87p. (DOCKET-50374-24). Dep. NTIS.

The preliminary safety analysis report for the La Salle County Power Reactor Units 1 and 2 is supplemented by the submission of revised and additional safety information. (D.C.C.)

47537 (DOCKET-50376-34) AGUIRRE NUCLEAR PLANT, UNIT 1. Preliminary Facility Analysis Report, Amendment 18. (Puerto Rico Water Resources Authority, San Juan). 30 Jun 1972. 125p. Dep. NTIS.

The preliminary safety analysis report for the Aguirre Power Reactor, Unit 1 is amended by the submission of requested additional information. (H.D.R.)

47538 (DOCKET-50382-25) WATERFORD STEAM ELECTRIC STATION, UNIT 3. Preliminary Safety Analysis Report, Amendment 17. (Louisiana Power and Light Co., New Orleans). 17 Jul 1972. 173p. Dep. NTIS.

The preliminary safety analysis report for the Waterford Power Reactor Unit 3 is supplemented by the submission of requested additional safety information. (D.C.C.)

47539 (DOCKET-50382-27) WATERFORD STEAM ELECTRIC STATION, UNIT 3. Environmental Report, Supplement 1. (Louisiana Power and Light Co., New Orleans). 24 Jul 1972. 87p. Dep. NTIS.

The environmental report for the Waterford Power Reactor Unit 3 is supplemented by the submission of requested information for the facility. (D.C.C.)

47540 (DOCKET-50382-28) WATERFORD STEAM ELECTRIC STATION, UNIT 3. Preliminary Safety Analysis Report, Amendment 19. (Louisiana Power and Light Co., New Orleans). 31 Jul 1972. 61p. Dep. NTIS.

The preliminary safety analysis report for the Waterford Power Reactor Unit 3 is supplemented by the submission of revised and additional safety information. (D.C.C.)

47541 (DOCKET-50382-29) WATERFORD STEAM ELECTRIC STATION, UNIT 3. Application for Construction Exemption. (Louisiana Power and Light Co., New Orleans). 11 May 1972. 27p. Dep. NTIS.

47542 (DOCKET-50382-30) WATERFORD STEAM ELECTRIC STATION, UNIT 3. Basic Data for a Source Term Calculation. (Louisiana Power and Light Co., New Orleans). 17 May 1972. 21p. Dep. NTIS.

47543 (DOCKET-50382-31) WATERFORD STEAM ELECTRIC STATION, UNIT 3. Environmental Report, Supplement 2. (Louisiana Power and Light Co., New Orleans). 15 Aug 1972. 75p. Dep. NTIS.

The environmental report for the Waterford Power Reactor Unit 3 is supplemented by the submission of revised and requested information for the facility. (D.C.C.)

47544 (DOCKET-50382-32) WATERFORD STEAM ELECTRIC STATION, UNIT 3. Preliminary Safety Analysis Report, Amendment 20. (Louisiana Power and Light Co., New Orleans). 15 Aug 1972. 85p. Dep. NTIS.

The preliminary safety analysis report for the Waterford Power Reactor Unit 3 is amended by the submission of revised and requested safety information. (D.C.C.)

47545 (DOCKET-50387-19) SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2. Environmental Report, Revised July 1972, Vol. 1. (Pennsylvania Power and Light Co., Allentown). 7 Jul 1972. 339p. (DOCKET-50388-19). Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactors is presented. The effects of reactor operations on the environment are analyzed. Ecological, geological, hydrological, and meteorological data for the reactor site are included. Cost-benefit analysis for reactor operations is presented. (D.C.C.)

47546 (DOCKET-50387-20) SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2. Environmental Report, Revised July 1972, Vol. 2. (Pennsylvania Power and Light Co., Allentown). 7 Jul 1972. 365p. (DOCKET-50388-20). Dep. NTIS.

Ecological, geological, hydrological, and meteorological data for the facility site are presented. (D.C.C.)

47547 (DOCKET-50387-21) SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 5, Revision. (Pennsylvania Power and Light Co., Allentown). Jul 1972. 2p. (DOCKET-50388-21). Dep. NTIS.

47548 (DOCKET-50387-22) SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 8. (Pennsylvania Power and Light Co., Allentown). 4 May 1972. 29p. (DOCKET-50388-22). Dep. NTIS.

The preliminary safety analysis report for the Susquehanna Power Reactor, Units 1 and 2 is amended by the submission of requested additional information. (H.D.R.)

47549 (DOCKET-50387-23) SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 9. (Pennsylvania Power and Light Co., Allentown). 28 Jul 1972. 28p. (DOCKET-50388-23). Dep. NTIS.

The preliminary safety analysis report of the Susquehanna Power Reactor, Units 1 and 2 is amended by the submission of revised information. (H.D.R.)

47550 (DOCKET-50390-17) WATTS BAR NUCLEAR PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 9. (Tennessee Valley Authority, Chattanooga). 19 Jun 1972. 82p. (DOCKET-50391-17). Dep. NTIS.

Maximum possible flood conditions for the reactor site are analyzed. (D.C.C.)

47551 (DOCKET-50390-18) WATTS BAR NUCLEAR PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 11. (Tennessee Valley Authority, Chattanooga). 19 Jul 1972. 319p. (DOCKET-50391-18). Dep. NTIS.

The preliminary safety analysis report for the Watts Bar Power Reactor Units 1 and 2 is supplemented by the submission of revised and additional safety information. (D.C.C.)

47552 (DOCKET-50390-19) WATTS BAR NUCLEAR PLANT, UNITS 1 AND 2. Application for License, Amendment 12. (Tennessee Valley Authority, Chattanooga). 11 Aug 1972. 51p. (DOCKET-50391-19). Dep. NTIS.

The application for construction permits for the Watts Bar Power Reactor, Units 1 and 2 is amended by the submission of revised organizational and financial information. (H.D.R.)

47553 (DOCKET-50395-22) VIRGIL C. SUMMER NUCLEAR STATION, UNIT 1. Preliminary Safety Analysis Report, Amendment 10. (South Carolina Electric and Gas Co., Columbia). 10 Jul 1972. 494p. Dep. NTIS.

The preliminary safety analysis report of the Virgil C. Summer Power Reactor, Unit 1 is amended by the submission of revised and requested additional information. (H.D.R.)

47554 (DOCKET-50395-24) VIRGIL C. SUMMER NUCLEAR STATION, UNIT 1. Preliminary Safety Analysis Report, Amendment 12. (South Carolina Electric and Gas Co., Columbia). 1 Aug 1972. 97p. Dep. NTIS.

The preliminary safety analysis report for the Virgil C. Summer Power Reactor, Unit 1 is amended by the submission of additional information. (H.D.R.)

47555 (DOCKET-50395-25) VIRGIL C. SUMMER NUCLEAR STATION, UNIT 1. Preliminary Safety Analysis Report, Amendment 13. (South Carolina Electric and Gas Co., Columbia). 4 Aug 1972. 45p. Dep. NTIS.

The preliminary safety analysis report for the Virgil C. Summer Power Reactor Unit 1 is supplemented by the submission of revised and additional safety information. (D.C.C.)

47556 (DOCKET-50397-19) HANFORD NO. 2 NUCLEAR POWER PLANT. Preliminary Safety Analysis Report, Amendment 7. (Washington Public Power Supply System, Richland). 7 Jul 1972. 465p. Dep. NTIS.

Revised and additional data are presented concerning the reactor site. Requested information is also presented concerning design parameters and operations aspects of the reactor. (D.C.C.)

47557 (DOCKET-50397-20) HANFORD NO. 2 NUCLEAR POWER PLANT. Preliminary Safety Analysis Report, Amendment 8. (Washington Public Power Supply System, Richland). 31 Jul 1972. 46p. Dep. NTIS.

The preliminary safety analysis report for the Hanford Power Reactor Unit 2 is supplemented by the submission of revised and additional safety information. (D.C.C.)

47558 (DOCKET-50397-21) HANFORD NO. 2 NUCLEAR POWER PLANT. Preliminary Safety Analysis Report, Amendment 9. (Washington Public Power Supply System, Richland). 7 Aug 1972. 138p. Dep. NTIS.

The preliminary safety analysis report for the Hanford Power Reactor Unit 2 is amended by the submission of revised and requested safety information. (D.C.C.)

47559 (DOCKET-50398-11) MENDOCINO POWER PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 7. (Pacific Gas and Electric Co., San Francisco, Calif.). 5 Jul 1972. 257p. (DOCKET-50399-11). Dep. NTIS.

The preliminary safety analysis report for the Mendocino Power Reactor, Units 1 and 2 is amended by the submission of revised and requested additional information. (H.D.R.)

47560 (DOCKET-50398-15) MENDOCINO POWER PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 9. (Pacific Gas and Electric Co., San Francisco, Calif.). 21 Jul 1972. 22p. (DOCKET-50399-15). Dep. NTIS.

The preliminary safety analysis report for the Mendocino Power Reactor Units 1 and 2 is supplemented by the submission of requested information on site geology and seismology. (D.C.C.)

47561 (DOCKET-50398-16) MENDOCINO POWER PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 10. (Pacific Gas and Electric Co., San Francisco, Calif.). 2 Aug 1972. 313p. (DOCKET-50399-16). Dep. NTIS.

The preliminary safety analysis report for the Mendocino Power Reactor Units 1 and 2 is supplemented by the submission of revised and additional safety information. (D.C.C.)

47562 (DOCKET-50398-17) MENDOCINO POWER PLANT, UNITS 1 AND 2. Opinion of Department of Justice with Respect to Monopolistic Activity. (Department of Justice, Washington, D. C. Antitrust Div.). 2 Aug 1972. 16p. (DOCKET-50399-17). Dep. NTIS.

47563 (DOCKET-50400-19) SHEARON HARRIS NUCLEAR POWER PLANT, UNITS 1, 2, 3, AND 4. Preliminary Safety Analysis Report, Amendment 10. (Carolina Power and Light Co., Raleigh, N. C.). 17 Jul 1972. 640p. (DOCKET-50401-19; DOCKET-50402-19; DOCKET-50403-19). Dep. NTIS.

Revised and additional data are presented concerning design parameters and operations aspects of the Shearon Harris Power Reactor Units 1, 2, 3, and 4. (D.C.C.)

47564 (DOCKET-50400-20) SHEARON HARRIS NUCLEAR POWER PLANT, UNITS 1, 2, 3, AND 4. Preliminary Safety Analysis Report, Amendment 11. Environmental Report, Volume 2. (Carolina Power and Light Co., Raleigh, N. C.). 24 Jul 1972. 105p. (DOCKET-50401-20; DOCKET-50402-20; DOCKET-50403-20). Dep. NTIS.

The environmental report for the Shearon Harris Power Reactor Units 1, 2, 3, and 4 is supplemented by the submission of requested additional information for the facility. (D.C.C.)

47565 (DOCKET-50400-21) SHEARON HARRIS NUCLEAR POWER PLANT, UNITS 1, 2, 3, AND 4. Preliminary Safety Analysis Report, Amendment 12. (Carolina Power and Light Co., Raleigh, N. C.). 7 Jul 1972. 350p. (DOCKET-50401-21; DOCKET-50402-21; DOCKET-50403-21). Dep. NTIS.

The preliminary safety analysis report for the Shearon Harris Power Reactor Units 1, 2, 3, and 4 is supplemented by the submission of requested additional safety information. (D.C.C.)

47566 (DOCKET-50404-18) NORTH ANNA POWER STATION, UNITS 3 AND 4. Preliminary Safety Analysis Report, Amendment 5. (Virginia Electric and Power Co., Richmond). 23 Jun 1972. 125p. (DOCKET-50405-18). Dep. NTIS.

The preliminary safety analysis report of the North Anna Power Reactor, Units 3 and 4 is amended by the submission of revised and additional data. (H.D.R.)

47567 (DOCKET-50404-19) NORTH ANNA POWER STATION, UNITS 3 AND 4. Preliminary Safety Analysis Report, Amendment 6. (Virginia Electric and Power Co., Richmond). 3 Jul 1972. 19p. (DOCKET-50405-19). Dep. NTIS.

The preliminary safety analysis report for the North Anna Power Reactor, Units 3 and 4 is amended by the submission of requested additional information. (H.D.R.)

47568 (DOCKET-50404-20) NORTH ANNA POWER STATION, UNITS 3 AND 4. Department of Justice Opinion With Respect to Monopolistic Action. (Department of Justice, Washington, D. C. Antitrust Div.). 1 May 1972. 9p. (DOCKET-50405-20). Dep. NTIS.

47569 (DOCKET-50409-4) LA CROSSE BOILING WATER REACTOR. Technical Specifications, Change in Plant Organization. (Dairyland Power Cooperative, La Crosse, Wis.). 12 Jul 1972. 3p. Dep. NTIS.

47570 (DOCKET-50409-5) LA CROSSE BOILING WATER REACTOR. Application of Conversion of the Provisional Operating Authorization to a Provisional Operating License, Amendment 1. (Dairyland Power Cooperative, La Crosse, Wis.). 21 Jul 1972. 3p. Dep. NTIS.

Additional information is presented concerning financial data, radiation sources, and fuel inventory. (D.C.C.)

47571 ARE LICENSING DELAYS REALLY NECESSARY? Males, Rene H. (Commonwealth Edison Co., Chicago). Power; 116: No. 6, 80-1(Jun 1972).

A simplified licensing procedure and an improved method for coordinating activities between the numerous agencies involved in licensing power plant construction are recommended. (auth)

47572 SIMULATORS. Turner, James (Electronic Associates, Inc., Princeton, N. J.). Power Eng.; 76: No. 6, 26-32 (Jun 1972).

The development of simulators for nuclear power plant operator training is examined, and features of existing facilities are described. (H.D.R.)

47573 EXPERIENCE IN THE LICENSING OF NUCLEAR POWER PLANTS. Bliss, Henry E.; Stiede, Wayne L. (Commonwealth Edison Co., Chicago). Nucl. News; 15: No. 6, 59-62; 65 (Jun 1972).

Bringing a nuclear power plant into a utility system involves the acquisition of a number of permits and licenses. The permit chronology of nuclear units is described and some comments and ideas on three aspects of the licensing procedure which contribute to delay are presented. (auth)

47574 CRITERIA FOR SELECTING THE LOCATION OF NUCLEAR PLANTS. Amaldi, Ugo Jr.; Campos Venuti, Gloria; Frullani, Salvatore; Maiani, Luciano; Tabet, Eugenio. Ann. Ist. Super. Sanita; 7: 626-46(1971). (In Italian).

Site selection criteria regarding nuclear power plants are summarized for a number of countries: USA, Japan, Germany, Canada, Great Britain, and Italy. The Italian criteria are amplified for purposes of discussion; examination of a proposed site for a nuclear plant raises questions of ecology, legislative disposition (protection of nearby nuban zones), natural dangers such as earthquakes, the quality of components of the nuclear installation, and the capability of the site relative to emergency handling. 30 references. (K.S.W.)

Steam and Power Conversion System

47575 (DOCKET-50220-102) NINE MILE POINT NUCLEAR STATION, UNIT 1. Results of Test on Main Steam Line Isolation Valves. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 1 Aug 1972. 2p. Dep. NTIS.

47576 (DOCKET-50244-108) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Pressurizer Safety Valves. (Rochester Gas and Electric Corp., N. Y.). 17 Jul 1972. 207p. Dep. NTIS.

A design study is presented for modifications to the Robert E. Ginna Power Reactor, Unit 1 main steam safety valve supports. Also included is a dynamic analysis of the pressurizer safety valve discharge piping. (H.D.R.)

Propulsion and Auxiliary Power Reactors

47577 NERVA FLIGHT ENGINE CONTROL SYSTEM DESIGN. Norman, H. H. (Westinghouse Electric Corp., Sacramento, Calif.); Parziale, E. A.; Salujs, J. K.; Schenz, R. F. Jr. Nucl. Technol.; 15: No. 3, 447-54(Sep 1972).

Modern control system theory was applied to the design of the control system for the NERVA nuclear rocket engine. Multiloop classical controls design approach was used previously in the engine test program. The configuration and operation of the engine system with the resulting high degree of coupling and the multivariable nature of the system establishes a need for modern control techniques with considerable advantages over classical methods. The design procedure consists of system model linearization, system simplication, and the quadratic optimal control design. Transient performance results were obtained from digital implementation of the control system. 11 references. (auth)

47578 ANALOGOVOE MODELIROVANIE SUDOVYKH YADERNYKH PAROPROIZVODYASHCHIKH USTANOVOK. (Analog Models of Marine Nuclear Steam Generating Plants). Sergeev, V. L. Leningrad; Izdatel'stvo Sudostroenie (1971). 352p.

Methods of model simulation of non-steady-state processes in

marine nuclear steam-producing installations are examined on electronic analog computers. Model simulation of neutron processes, non-steady-state heat transfer in reactors, heat exchange, steam generators, and heat lag in turboducts are described. Basic units of steam generating plants are treated as systems of distributed parameters in an analysis of their performances. 81 references. (K.S.W.)

Process Heat and Desalination Reactors

47579 PRELIMINARY REMARKS ABOUT LARGE-SCALE DESALINATION AND DUAL PURPOSE PLANTS. Ahmad, Mohammad (Pakistan Atomic Energy Commission, Karachi). Nucleus (Karachi); 8: No. 4, 43-54(1971).

The growing need of saline water conversion vis-a-vis the global inventory of water substance is briefly discussed. Water shortage also exists in Pakistan and areas where desalination technology can be called upon to provide either the only source of potable water or to supplement the existing means of fresh water supply are described. The status of desalting methods and preliminary factors in the choice of large-scale desalination, especially by means of dual-purpose plants, are presented. (auth)

Research and Test Reactors

Refer also to abstract: 45673.

47580 (CISE-R-259) ANALOG COMPUTER MODELS FOR THE SAFETY EVALUATION OF THE CART FUEL TEST FACILITY. Leoni, G.; van Erp, J. B. (Centro Informazioni Studi Esperienze, Milan (Italy)). Dec 1967. 29p. Dep. NTIS (U. S. Sales Only).

Analog computer models used for the evaluation of some of the safety aspects of the CART fuel test facility are presented. Information is included on the consequence on the CART test-section of loss-of-flow accidents affecting directly the CART facility and the consequence on the CART test-section of a reactivity accident at power in the ESSOR reactor. (auth)

47581 (CEA-N-1483) MASURCA: STUDY OF PLUTONIUM–GRAPHITE AND URANIUM–GRAPHITE ASSEMBLIES. Tretiakoff, O.; Barberger, M.; Boyer, J.; (and others) (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Sep 1971. 132p. (In French). Dep. NTIS (U. S. Sales Only).

During the December 1966 to March 1969 period, assemblies with either 30% enriched uranium, or a uranium–plutonium–iron alloy and graphite mixtures were studied in a fast neutron critical mock-up (MASURCA) at Cadarache. The operation of this mock-up enabled problems associated with the reactor operation to be examined. Cores were chosen because of their simplicity and their spectrum, which approximates that of fast power reactors. Measurement techniques were developed for these cores. Future experimental programs concerning the assemblies are described. Critical size, buckling by fission rate mappings, and reactivity coefficient determination using the oscillation technique are described. The results concerning different measured parameters are presented and various values for the reactivity coefficients are given. 8 references. (France)

47582 (DOCKET-50231-120) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. Modification Proposed for Decommissioning Plan. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). 28 Jun 1972. 5p. Dep. NTIS.

47583 (DOCKET-50231-121) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. Request for Issuance of Dismantling Order. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). 18 Jul 1972. 2p. Dep. NTIS.

47584 (DOCKET-50231-122) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. Technical Specifications, Change 13. (Directorate of Licensing (AEC), Washington, D. C.). 21 Jul 1972. 1p. Dep. NTIS.

Revised technical specifications are presented concerning personnel requirements for site security. (D.C.C.)

47585 (EURFNR-1008) INFLUENCE OF FISSION NEUTRON SPECTRA ON INTEGRAL NUCLEAR QUANTITIES OF FAST REACTORS. Kiefhaber, E.; Thiem, D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Mar 1972. 34p. (KFK-1561). Dep. NTIS (U. S. Sales Only).

Work performed under United States–Euratom Fast Reactor Exchange Program.

The influence of fission neutron spectra on important integral quantities of fast critical assemblies is discussed. The forms of the fission spectra are taken from the KEDAK and ENDF/B library respectively. The different forms are compared with each other and with the "standard" fission spectrum generally used in the calculations which belongs to $\nu = 2.8$ of the Russian ABN-set of group constants. The influence of the different forms on calculated integral quantities for fast critical assemblies and on important characteristics of large fast power reactors is investigated. Some implications for the programs used to calculate flux distributions are outlined. 19 references. (auth)

47586 (HEDL-TME-72-42) THREE DIMENSIONAL NEUTRONICS CALCULATIONS FOR THE FAST TEST REACTOR (FTR) AND THE FTR ENGINEERING MOCK UP CRITICAL ASSEMBLY (EMC). Fleischman, R. M.; Nelson, J. V. (Hanford Engineering Development Lab., Richland, Wash.). Apr 1972. Contract AT(45-1)-2170. 68p. Dep. NTIS.

The three-dimensional diffusion theory code, 3DB, was used to make full-core, detailed, thirty energy group, neutronics calculations of the FTR and EMC. Eigenvalue and reaction rate distribution calculations for the EMC are presented and the latter are compared with experiment. The FTR criticality search using target eigenvalues derived from EMC calculations and calculation of the FTR Doppler coefficient in the established critical configuration are discussed. Reaction rate and power distributions and neutron energy spectra from FTR calculations are presented. Appended to the report are complete cross section and three-dimensional modeling details, and a discussion of 3DB convergence behavior. 13 references. (auth)

47587 EVALUATION OF ABSORBER MATERIALS PERFORMANCE IN HFIR CONTROL CYLINDERS. Knight, R. W.; Richt, A. E. (Oak Ridge National Lab., Tenn.). Nucl. Technol.; 15: No. 3, 384-90(Sep 1972).

The irradiation behavior of the High Flux Isotope Reactor (HFIR) control cylinders was assessed. After 48,000 MWd of irradiation, the nuclear worth of the control cylinder was not changed significantly. The maximum surface oxide buildup was 0.003 to 0.005 in. thick and occurred over the Ta–Al dispersion. The hardness of the 6061 Al cladding was found to have increased from 45 DPH at the low burnup end of the cylinder to 110 DPH over the Ta–Al region which is located approximately 5 in. below the area of maximum fast-neutron fluence. Extensive metallographic examination revealed no degradation or reaction in either the Ta–Al or Eu_2O_3–Al portions of the cylinder. (auth)

47588 FIRST INDIAN REACTOR. Zamb, N. K. (Bhabha Atomic Research Centre, Bombay). Vaigyanik; 2: No. 1, 3-4; 30(2 Apr 1970). (In Hindi).

Apsara reactor that went critical on August 4, 1956, is the first Indian reactor designed and fabricated wholly by Indian scientists and engineers. It is a swimming pool type reactor and uses water as coolant. The reactor is fuelled with enriched uranium and has a maximum power rating of 1,000 kilowatts thermal but is normally operated at 400 kW. The reactor pool, core assembly, coolant system and control system are described. Apsara reactor is used for research experiments in physics, chemistry and biology, and for the production of radioisotopes. (INIS)

47589 MINERVE REACTOR. Bouchard, J.; Carre, J. C. (CEN, Fontenay-aux-Roses, France). Bull. Inform. Sci. Tech. (Paris); No. 168, 17-28(Mar 1972). (In French).

Minerve is low power experimental reactor designed, essentially, for neutron studies (in particular using the oscillation method). After a description of the equipment used in conjunction with this reactor, the principal experiments undertaken since 1959 are reviewed: cross section measurements, resonance integral measurements, study of the behavior of Pu in heavy water lattices, and kinetic studies. The central cavity of Minerve has great adaptability; in 1966 a simple modification enabled Minerve to be converted into a fast-thermal coupled assembly, Ermine. The results obtained with this assembly in the development of fast neutron reactor assemblies are exposed. (France)

47590 HARMONIE REACTOR. Lyon, F.; Oceraies, R.; Desprets, A. (CEN de Cadarache, Saint-Paul-les-Durance, France). Bull. Inform. Sci. Tech. (Paris); No. 168, 45-56(Mar 1972). (In French).

The Harmonie reactor (a low power fast neutron source) is described. It can be used to provide neutrons having a thermal or hard spectrum, or as a plane source. It is well suited to exponential experiments with fast media, e.g., U or Pu. Harmonie was also used for studying shielding problems encountered with fast neutron reactors: basic research and research using mockups. (France)

47591 CALCULATIONS AND BEHAVIOR OF EXPANSION BELLOWS. Roche, R.; Vrillon, B. (CEN de Saclay, Gif-sur-Yvette, France). Bull. Inform. Sci. Tech. (Paris); No. 167, 47-51(Feb 1972). (In French).

Because of their empirical nature, calculations concerning the behavior of expansion bellows for the channels of nuclear reactors have not always been entirely satisfactory. In 1952 the SEMT became interested in this problem. A simplified formula was developed. Recent developments in calculations using the finite element method have led to considerable progress in the treatment of this problem. The method is particularly useful for calculating the real geometry of the wave profiles. (France)

47592 EXPERIMENTAL REACTOR MASURCA. Boyer, J.; Bruna, J. (CEN de Cadarache, Saint-Paul-les-Durance, France). Bull. Inform. Sci. Tech. (Paris); No. 168, 57-69(Mar 1972). (In French).

Masurca is a fast neutron experiment installed at Cadarache. It is used to simulate the cores of experimental and power reactors. This reactor is very adaptable and presents a very high operational safety. It has been used since 1969 to study media having compositions similar to those of the two zones of the Phenix reactor. (France)

Reactor Components, Fuels, and Accessories

Refer also to abstracts: 45424, 45933, 45939, 45957, 45959, 45960, 45974, 45996, 46067, and 46077.

47593 (RDT-E-14-6-T(6-72)) GASKETS-CONTAINMENT VESSEL AIRLOCK. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jun 1972. 10p. RSO.

The requirements for design, manufacture, installation, and test requirements for gasket installations for sealing doors in nuclear power system containment vessel airlocks, are presented. (auth)

Reactor Physics and Core Engineering

Physics

47594 (BMBW-FBK-72-6) COMPUTER-CODE FOR THE SOLUTION OF THE THREE-DIMENSIONAL-MULTIGROUP-EQUATIONS, BASED ON THE IMPROVED SYNTHESIS-METHOD. Schaeffler, H.; Schnur, P.; Ruehle, R. (Technische Universitaet, Brunswick (West Germany)). May 1972. 81p. (In German). Dep. NTIS (U. S. Sales Only).

A FORTRAN IV-code based on the improved flux synthesis method was developed. This method allows the use of separate sets of trial functions in different axial regions of a reactor. However, the continuity of the neutron flux distribution at the region boundaries is guaranteed. The theory of the improved method is presented. The results of numerical tests described demonstrate the advantage of this technique. Computing time has been considerably reduced in comparison with conventional difference calculations of equal accuracy. Fields of application for the code are discussed and a computer-code-abstract is presented. 13 references. (auth)

47595 DETERMINATION OF RATIOS OF EFFECTIVE CROSS SECTIONS FROM MEASURED BURNUP DATA FOR YANKEE ROWE. Matsen, R. P. (Battelle-Northwest Labs., Richland, Wash.). Nucl. Technol.; 15: No. 3, 343-53(Sep 1972).

A technique for obtaining cross-section information from experimental isotopic concentration data was applied to the data from Yankee Core I. The technique involves making a least-squares fit of appropriate transmutation equations to the data. The analysis covers two transmutation chains. One is the plutonium chain which begins with ^{238}U and ends with americium and curium. The other is a rarer isotope chain which begins with ^{235}U or ^{238}U and ends with neptunium and plutonium. Values were obtained for twelve ratios determined by the least squares analysis (e.g., $\alpha^{25} = 0.2569 \pm 0.0023$ and $\alpha^{49} = 0.622 \pm 0.082$). In order to obtain information about the less abundant transuranium isotopes, fifteen Yankee Core I samples were analyzed for their isotopic content. The ratios of effective cross sections were also deduced from the data. 9 references. (auth)

Core Thermal Hydraulics

47596 CROSS FLOW RESISTANCE IN ROD BUNDLE CORES. Weisman, Joel (Univ. of Cincinnati). Nucl. Technol.; 15: No. 3, 465-9(Sep 1972).

Experimental data have shown a high resistance to cross flow in the presence of large axial flows. This phenomenon may be explained by use of a full lateral momentum balance. Application of the momentum balance principle shows that inter-channel cross flow at any given level depends on the cross flow at the lower level in addition to the local pressure gradient. This revised procedure for calculation of cross flow should eventually lead to improved estimation of core wide flow redistribution in open lattice cores. (auth)

GENERAL

Civilian Defense

47597 (EUR–4806) DEFINITIONS OF PROPER NAME DESCRIPTORS USED IN THE EURATOM-INIS NUCLEAR DOCUMENTATION SYSTEM. Vernimb, C. (European Communities, Brussels (Belgium). Commission. European Atomic Energy Community, Luxembourg. Center for Information and Documentation). Mar 1972. 62p. Dep. NTIS (U. S. Sales Only). EUR B. Fr. 85.-.

440 definitions are given of so-called Proper Name Terms, which are used as descriptors in the EURATOM-INIS Nuclear Documentation System. These definitions are intended to give an aid in indexing and retrieval. (auth)

Law

Refer also to abstracts: 45803 and 45804.

47598 (UCID–30047) CATALOG OF LLL COMPUTER DOCUMENTATION REPORTS. Norem, W. L. (California Univ., Livermore. Lawrence Livermore Lab.). 10 May 1972. Contract W-7405-Eng-48. 301p. Dep. NTIS.

A catalog of all unclassified reports issued by the Lawrence Livermore Laboratory and pertaining to computer documentation is given. The reports primarily deal with computers and programs of the Livermore Time-Sharing System. (auth)

Miscellaneous

47599 (ANL-TKK/RJL–2) "FORGY:" A COMPANION COMPUTER PROGRAM OF "TRIM" TO CALCULATE FORCES AND ENERGY IN ELECTROMAGNETS. Khoe, T. K.; Lari, R. J. (Argonne National Lab., Ill.). 4 Jan 1972. 26p. Dep. NTIS.

47600 (BDX–613–253(Rev.)) SYNTACTIC FOAM, FY70-3. Quarterly Report. Johnston, J. R. (Bendix Corp., Kansas City, Mo.). Feb 1972. Contract AT(29-1)-613. 54p. Dep. NTIS.

47601 (BDX–613–288(Rev.)) HIGH-TEMPERATURE THERMAL INSULATION. Quarterly Report, FY 70-3. Fotopoulos, C. U. (Bendix Corp., Kansas City, Mo.). Sep 1971. Contract AT(29-1)-613. 32p. Dep. NTIS.

47602 (BDX–613–392(Rev.)) LIQUID PROCESSING OF MOLDED DESICCANT. Hefner, Bruce A. (Bendix Corp., Kansas City, Mo.). Jan 1972. Contract AT(29-1)-613. 34p. Dep. NTIS.

47603 (BDX–613–440(Rev.)) DEVELOPMENT OF ELASTOMER CUSHIONS, FY69-4. Quarterly Report. Green, R. M. (Bendix Corp., Kansas City, Mo.). Oct 1971. Contract AT-(29-1)-613. 32p. Dep. NTIS.

47604 (BDX–613–456) COMPUTER SIMULATION MODELING OF AN AUTOMATED WAREHOUSE SYSTEM. Report on Phase II of a Three-Phase Automated Warehouse Study. Smith, Jerry C. (Bendix Corp., Kansas City, Mo.). Nov 1971. Contract AT(29-1)-613. 79p. Dep. NTIS.

47605 (BDX–613–515(Rev.)) EFFECT OF SODIUM HYDROXIDE ON ALUMINUM FOIL THICKNESS. Bengtson, Glenn W. (Bendix Corp., Kansas City, Mo.). Oct 1971. Contract AT(29-1)-613. 20p. Dep. NTIS.

47606 (BDX–613–543(Rev.)) HIGH-DENSITY BRAID CABLE SHIELD, FY72-1. Quarterly Report. Galbraith, J. F. (Bendix Corp., Kansas City, Mo.). Feb 1972. Contract AT(29-1)-613. 11p. Dep. NTIS.

47607 (BDX–613–579(Rev.)) AUTOCLAVE FABRICATION TECHNIQUES FOR FLAT CABLES. Final Report. Sheeley, J. D. (Bendix Corp., Kansas City, Mo.). Feb 1972. Contract AT(29-1)-613. 24p. Dep. NTIS.

47608 (BDX–613–604(Rev.)) DETERMINATION OF SEMICONDUCTOR JUNCTION PROFILES BY ANGLE LAPPING OF SEMICONDUCTOR WAFERS. Rauch, E. L. (Bendix Corp., Kansas City, Mo.). Feb 1972. Contract AT(29-1)-613. 17p. Dep. NTIS.

47609 (BDX–613–642(Rev.)) THERMAL SHOCK DEBURRING. Final Report. Kuehnle, J. H. (Bendix Corp., Kansas City, Mo.). Jun 1972. Contract AT(29-1)-613. 45p. Dep. NTIS.

47610 (COO–2118–34) PART 1: ANNUAL TECHNICAL PROGRESS REPORT, OCTOBER 1, 1971–JUNE 30, 1972. McCormick, Bruce H. (Illinois Univ., Urbana. Dept. of Computer Science). 30 Jun 1972. Contract AT(11-1)-2118. 94p. Dep. NTIS.

47611 (COO–3078–5) EARLY STEPS IN PROTEIN SYNTHESIS AND THEIR REGULATION: A BACKGROUND STUDY RELATED TO THE BIOLOGICAL EFFECTS OF RADIATION. Progress Report, September 1, 1971–August 31, 1972. (Massachusetts General Hospital, Boston. John Collins Warren Labs.). 1972. Contract AT(11-1)-3078. 26p. Dep. NTIS.

47612 (COO–3078–6) AN INVESTIGATION ON THE MECHANISM OF PROTEIN AND NUCLEIC ACID SYNTHESIS: A BACKGROUND STUDY RELATED TO THE BIOLOGICAL EFFECTS OF RADIATION. Dodecennial Progress Report, September 1, 1960–August 31, 1972. (Massachusetts General Hospital, Boston. John Collins Warren Labs.). 1972. Contract AT(11-1)-3078. 11p. Dep. NTIS.

47613 (COO–3292–1) STUDY ON THE CHEMICAL BEHAVIOR OF ZINC IN CHESAPEAKE BAY WATER USING ANODIC STRIPPING VOLTAMMETRY. Technical Report 76. Bradford, Wesley Lamont (Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.). Jun 1972. Contract AT(11-1)-3292. 113p. Dep. NTIS.

47614 (COO–3498–2) FUNDAMENTAL STUDIES IN ISOTOPE CHEMISTRY. Progress Report, July 1, 1971–June 30, 1972. Bigeleisen, Jacob (Rochester Univ., N. Y.). 1972. Contract AT(11-1)-3498. 7p. Dep. NTIS.

47615 (CU–3194–22) ANELASTIC RELAXATION CAUSED BY POINT DEFECTS IN MnF_2. Srinivasan, Nenmeli Krishnaswami (Columbia Univ., New York. Henry Krumb School of Mines). Apr 1972. Contract AT(11-1)-3194. 92p. Dep. NTIS.

47616 (EUR–4832) POSTGRADUATE TRAINING OF SCIENTISTS IN THE EUROPEAN COMMUNITY. Rouche, N. (Fondation Industrie-Universite, Brussels (Belgium)). 1972. 172p. (In French). Dep. NTIS (U. S. Sales Only). EUR FB 225,-.

47617 (IEA–19) SELECTED TOPICS ON DYNAMICS OF CRYSTAL LATTICES. Borgonovi, G. M. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Nov 1971. 50p. Dep. NTIS (U. S. Sales Only).

47618 (JINR–P14–6407) NEW METHOD OF DETERMINATION OF PHYSICAL-CHEMICAL PROPERTIES OF MATTER. Zinov, V. G.; Konin, A. D.; Mukhin, A. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 5p. (In Russian). Dep. NTIS (U. S. Sales Only).

47619 (KY–642) CONDITIONS FOR THE REMOVAL OF CHROMATE FROM COOLING WATER. Lemonds, Alice J. (Paducah Gaseous Diffusion Plant, Ky.). 10 Jul 1972. Contract W-7405-eng-26. 10p. Dep. NTIS.

47620 (MIT–144) MATHEMATICAL MODEL FOR THE PREDICTION OF UNSTEADY SALINITY INTRUSION IN ESTUARIES. Thatcher, M. Llewellyn; Harleman, Donald R. F. (Massachusetts Inst. of Tech., Cambridge (USA). Ralph M. Parsons Lab. for Water Resources and Hydrodynamics). Feb 1972. 232p. (R–72-10; DSR–72602; DSR–73479).

47621 (ORNL-TM–3810) EXECUTION TIME TRANSLATE SUBROUTINES. Joseph, Allen F. (Oak Ridge National Lab., Tenn.). Jul 1972. Contract W-7405-eng-26. 38p. Dep. NTIS.

47622 (ORO–4245–4) STUDIES ON NUTRITION OF THE PREPLACENTAL EMBRYOS OF THE MAMMAL. Sixth Year Progress Report. (Tennessee Univ., Knoxville). 1972. Contract AT(40-1)-4245. 8p. Dep. NTIS.

47623 (RLO–2229-T-1-18) TRACE-METAL ASSOCIATIONS IN SUB-ARCTIC AND ARCTIC MARINE ENVIRONMENTS. Progress Report, June 1971–May 1972. Burrell, David C. (Alaska Univ., College. Inst. of Marine Science). May 1972. Contract AT(45-1)-2229. 136p. (R–72-8). Dep. NTIS.

Continuing research on trace-metal associations in the marine environment of the arctic and subarctic is described. Geological studies were made of the fiords of S.E. Alaska and coordinated with geochemical studies related to sedimentation dynamics, suspended sediment size fractionation, chemical composition of bottom sediments, distribution of Zn within the environment, and sedimental interstitial water chemistry. Information is included on gas-liquid chromatographic analysis of trace metals in seawater, solvent extraction techniques, and the use of atomic ab-

sorption spectrometry for measuring trace inorganic pollutants in the marine environment. (L.C.L.)

47624 (SC-CR-723142) HIGH-PEAK-POWER, HIGH-EFFICIENCY MICROCIRCUIT AVALANCHE DIODE OSCILLATORS. Liu, S. G. (RCA Labs., Princeton, N. J.). Jul 1972. Contract 11-2475. 84p. Dep. NTIS.
For Sandia Labs., Albuquerque, N. Mex.

47625 (SC-DC-722267) ANODE TEMPERATURES AND ION ENERGY DISTRIBUTIONS DURING A VACUUM ARC DISCHARGE. Grissom, J. T.; Newton, J. C. (Sandia Labs., Albuquerque, N. Mex.). 1971. 6p. (CONF-720807-1). Dep. NTIS.
From fifth international symposium on discharges and electrical insulation in vacuum; Poznan, Poland (31 Aug 1972).

47626 (SC-T-722520) LONGITUDINAL IMPACT ON THE END FACE OF PRISMATIC RODS, CYLINDRICAL, AND CONICAL SHELLS. Egorshin, A. A. Translated by Patricia Newman (Sandia Labs., Albuquerque, N. Mex.), from Samoletostr. Tekh. Vozdush. Flota; 13: 99-104(1968). 10p. Dep. NTIS.

47627 (SCL-RR-720270) AN INTRODUCTION TO COBORDISM THEORY. Rinne, R. L. (Sandia Labs., Livermore, Calif.). May 1972. Contract AT(29-1)-789. 23p. Dep. NTIS.

47628 (TID-3767) BIBLIOGRAPHIES OF ATOMIC ENERGY LITERATURE. Issued or in Progress During the Period April-June 1972. (Technical Information Center (AEC), Oak Ridge, Tenn.). 1972. 15p. TIC Free.

47629 (UCLA-12-866) SINGLE CELL TRANSPLANTS: GROSS VIRUS-INDUCED MOUSE LYMPHOMAS. Vredevoe, Donna L.; Hays, Esther F. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology). 1971. Contract AT(04-1)-Gen-12. 15p. Dep. NTIS.

47630 (UCLA-34-P-177-11) CONTRAST EFFECTS AT GRAIN BOUNDARY LEDGES IN 304 AUSTENITIC STAINLESS STEEL. McDonald, R. C.; Ardell, A. J. (California Univ., Los Angeles. School of Engineering and Applied Science). Apr 1972. Contract AT(04-3)-34. 4p. Dep. NTIS.

47631 (UCRL-51210) SHAKER: A COMPUTER PROGRAM FOR NUMERICAL ANALYSIS OF WEIGHTED TABULAR DATA. Edwards, Arthur L. (California Univ., Livermore. Lawrence Livermore Lab.). Jan 1972. Contract W-7405-eng-48. 262p. Dep. NTIS.
The SHAKER program was developed to meet a need for a single program capable of carrying out a wide variety of numerical processing procedures on weighted tabular data, with a minimum effort on the part of the user, and with maximum flexibility in the choice and sequence of the processing steps. Available procedures include least-squares fitting of weighted tabular data with a variety of functions, regression analysis, integration and differentiation, purging, smoothing, discontinuity measurement, linear mapping of coordinates, functional transformation, reordering, finding the ranges of table variables, weight factor adjustment, reduction of multi-valued tables to single-valued tables, merging of two or more tables, reduction of two parametric tables to a single table, alignment of two tables by translation and/or scaling, and many others. Procedures are provided for input and generation of tables, labeling of tables and table variables, manipulation and replication of tables in memory, and output of tables, including printed, punched, and graphical output. During a computer run, each procedure is specified and controlled by a card in the input file. The control cards may be arranged in any desired order to obtain the desired sequences of processing. FORTRAN listings of all of the routines in the SHAKER program are given. (auth)

47632 (UCRL-51227) DETERMINANT METHOD FOR CALCULATING SMALL-CRYSTAL ENTROPY. Hindmarsh, A. C.; Hoover, W. G. (California Univ., Livermore. Lawrence Livermore Lab.). 18 May 1972. Contract W-7405-eng-48. 40p. Dep. NTIS.

47633 (UCRL-51239) AN EFFICIENT HIGH-VOLUME MINIATURE AIR MOVER. Taylor, R. D. (California Univ., Livermore. Lawrence Livermore Lab.). 30 May 1972. Contract W-7405-eng-48. 9p. Dep. NTIS.

47634 (UCRL-73587) SOLID STATE RMS RECORDING AMMETER. Parker, Robert (California Univ., Livermore. Lawrence Livermore Lab.). 16 Dec 1971. 19p. (CONF-720706-1). Dep. NTIS.
From Power Engineering Society Summer meeting; San Francisco, CA. (9 Jul 1972).

47635 (UCRL-73805) SIMPLE METHOD FOR SEPARATING SPINDLE ERROR FROM TEST BALL ROUNDNESS ERROR. Donaldson, R. R. (California Univ., Livermore. Lawrence Livermore Lab.). 13 Mar 1972. 11p. (CONF-720809-1). Dep. NTIS.
From twenty-third meeting of the International Society of Electrochemistry; Stockholm, Sweden (27 Aug 1972).

47636 (UCRL-73925) SURFACE SCIENCE AND SURFACE DAMAGE. Khan, Jhan M. (California Univ., Livermore. Lawrence Livermore Lab.). 26 Jun 1972. 19p. (CONF-720625-1). Dep. NTIS.
From fourth symposium on damage in laser materials; Boulder, CO. (14 Jun 1972).

47637 (UR-49-1508) BIOLOGICAL PROPERTIES OF CERTAIN COMPOUNDS CONTAINING THE C-F BOND. Smith, Frank A. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1971. 36p. (CONF-710913-3). Dep. NTIS.
From 162nd national meeting of the American Chemical Society; Washington, D. C. (12 Sep 1971).

47638 (UR-3055-1) PASSIVE CATION FLUX CHANGES IN THE HUMAN ERYTHROCYTE SUSPENDED IN VARIOUS ANIONIC MEDIA. Callahan, Thomas Joseph (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1972. 157p. Dep. NTIS.
Thesis.

47639 (UR-3055-2) BACTERIOPHAGE T4 INHIBITS COLICIN E2-INDUCED DEGRADATION OF ESCHERICHIA COLI DEOXYRIBONUCLEIC ACID. Swift, Robert L. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1972. 98p. Dep. NTIS.
Thesis.

47640 (UR-3490-18) PROTEIN SYNTHESIS AND THE CELL CYCLE OF L5178Y CELLS. Roti Roti, Joseph Lee (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1971. 105p. Dep. NTIS.
Thesis.

47641 (UR-3490-21) PROCEDURE FOR CHRONIC INTRAVENOUS CATHETERIZATION IN THE RABBIT. Hall, Larry L.; De Lopez, Ofelia H.; Roberts, Anne; Smith, Frank A. (Rochester Univ., N. Y. School of Medicine and Dentistry). 1971. Contract AT(11-1)-3490. 13p. Dep. NTIS.

47642 (UR-3490-47) SPECTRAL STUDIES OF COLLAGEN. Shadbolt, Margaret Anne (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1971. 144p. Dep. NTIS.
Thesis.

47643 (UR-3490-80) EFFECT OF A POLYTHIOL SYNTHETIC RESIN ON THE ABSORPTION AND EXCRETION OF METHYLMERCURY IN EXPERIMENTAL ANIMALS. Clarkson, T. W.; Small, H.; Norseth, Tor (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1972. 13p. Dep. NTIS.

47644 (UR-3490-85) CHRONIC LOW-LEVEL NO_2 EXPOSURE AND THE MUCOCILIARY CLEARANCE MECHANISM IN THE RAT TRACHEA IN VIVO. Giordano, Anthony Michael Jr. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1972. 38p. Dep. NTIS.
Thesis.

47645 (UR-3490-107) FLUORINE METABOLITE CONCENTRATIONS AND RENAL CLEARANCES FOLLOWING METHOXYFLURANE ANESTHESIA. Fry, Bill W.; Taves, Donald R.; Merin, Robert G. (Rochester Univ., N. Y. School of Medicine and Dentistry). 1972. 27p. Dep. NTIS.

47646 (UR-3490-131) EFFECT OF VARYING DOSES OF CORTISOL ON THE INCORPORATION OF ^3H-THYMIDINE INTO RAT LIVER DNA AND ON THE SYNTHESIS OF FIVE PLASMA PROTEINS IN THE ISOLATED PERFUSED REGENERATING RAT LIVER. Lebda, Nancy Jean Abbott (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1972. 59p. Dep. NTIS.
Thesis.

47647 (UR-3490-132) EFFECTS OF CHLORAMPHENICOL AND CYCLOHEXIMIDE ON THE CELL GROWTH CYCLE OF MOUSE LEUKEMIC CELLS (L5178Y). Liberman, Daniel Franklin (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1972. 88p. Dep. NTIS.
Thesis.

47648 (UR-3490-137) PATHOPHYSIOLOGIC EFFECTS OF MICROWAVE RADIATION WITH SPECIAL REFERENCE TO THE THYROID-PITUITARY AXIS. Milroy, William C. (Rochester

Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1972. 114p. Dep. NTIS.
Thesis.

47649 (UR-3490-147) DISTRIBUTION OF AN ^{125}I-LABELED TRANSPLANTATION ANTIBODY IN SYNGENEIC AND ALLOGENEIC RATS. Izzo, Mary Jane; Buchsbaum, Donald J.; Bale, William F. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1972. 14p. Dep. NTIS.

47650 (UR-3490-153) EFFECTS OF ACTINOMYCIN D ON G_1 PROTEIN SYNTHESIS IN L5178Y CELLS. Roti Roti, J. L.; Okada, S.; Eberle, H. (Rochester Univ., N. Y. School of Medicine and Dentistry. Tokyo Univ. (Japan). Dept. of Radiation Biophysics). 1972. 12p. Dep. NTIS.

47651 (UR-3490-154) PROTEIN SYNTHESIS DURING THE CELL CYCLE OF L5178Y CELLS. Roti Roti, J. L.; Okada, S.; Eberle, H. (Rochester Univ., N. Y. School of Medicine and Dentistry. Tokyo Univ. (Japan). Dept. of Radiation Biophysics). 1972. Contract AT(30-1)-1286. 26p. Dep. NTIS.

47652 CANADIAN NATIONAL SCIENTIFIC AND TECHNICAL INFORMATION (STI) SYSTEM: A PROGRESS REPORT. Report No. 4, May 1972. Brown, Jack E. Philadelphia; National Federation of Science Abstracting and Indexing Services (1972). 28p. (NP-19360).

Appendix I
JOURNAL LIST

This list of journals supplements the listing which appeared as Appendix II in Volume 26, Number 1. The journals are arranged alphabetically by abbreviation.

The title abbreviations are based on the National Clearinghouse for Periodical Title Word Abbreviations, *Word Abbreviation List* published by the Standards Committee Z-39 of the American National Standards Institute.

TID-4579 (6th Ed.) *Serial Titles Cited in Nuclear Science Abstracts* lists the titles and abbreviations of the journals regularly scanned for *NSA* as well as those from which an occasional item is taken. This publication is available from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia, 22151, for $6.00 for full size or reproduction copy and $0.95 for microfiche copy.

A

Accident Anal. Prev. (Elmsford, N.Y.)
Accident Analysis and Prevention (Elmsford, New York) (U.S.)

Acta Radiobot. Genet.
Acta Radiobotanica et Genetica (Japan)

Acta Univ. Agr. (Brno), Ser. C
Acta Univ. Agr. (Brno), Series C (Facultas Silviculturae) (Czechoslovakia)

Acta Univ. Upsal., Abstr. Uppsala Diss. Fac. Sci.
Acta Universitatis Upsaliensis, Abstracts of Uppsala Dissertations from the Faculty of Science (Sweden)
Supersedes Acta Univ. Upsal., Abstr. Uppsala Diss. Sci.

Advan. Exp. Med. Biol.
Advances in Experimental Medicine and Biology (U.S.)

Advan. Instrum.
Advances in Instrumentation (U.S.)

Aerotec.-Missili Spazio
Aerotecnica-Missili e Spazio (Italy)
Formed by merger of Aerotecnica and Missili e Spazio

Ag Chem Commer. Fert.
Ag Chem and Commercial Fertilizer (U.S.)
Supersedes Agr. Chem.

Agra Univ. J. Res.
Agra University Journal of Research (India)

AIP (Amer. Inst. Phys.) Conf. Proc.
AIP (American Institute of Physics) Conference Proceedings (U.S.)

Alimenta (Zurich)
Alimenta (Zurich) (Switzerland)

Allianz Ber. Betriebstech. Schadenverhuetung
Allianz Berichte fuer Betriebstechnik und Schadenverhuetung (West Germany)

Amer. Chem. Soc., Div. Water, Air Waste Chem., Gen. Pap.
American Chemical Society, Division of Water, Air and Waste Chemistry, General Papers (U.S.)

Amer. Fam. Physician
American Family Physician (U.S.)
Supersedes American Family Physician - GP

An. Asoc. Quim. Argent.
Anales de la Asociacion Quimica Argentina (Argentina)

Ann. Acad. Sci. Fenn., Ser. A III
Annales Academiae Scientiarum Fennicae, Series A III. Geologica-Geographica (Finland)

Ann. Acad. Sci. Fenn., Ser. A V
Annales Academiae Scientiarum Fennicae, Series A V. Medical (Finland)

Ann. Agron.
Annales Agronomiques (France)

Ann. Sci. Forest.
Annales des Sciences Forestieres (France)

Ann. Univ. Sarav., Math.-Naturwiss. Fak.
Annales Universitatis Saravienis, (Reihe), Mathematisch-Naturwissenschaftliche Fakultaet (West Germany)

Annu. Rep. Progr. Chem., Sect. A
Annual Reports on the Progress of Chemistry, Section A. General, Physical and Inorganic Chemistry (England)

Annu. Rev. Mater. Sci.
Annual Review of Materials Science (U.S.)

An. Univ. Bucuresti, Chim.
Analele Universitatii Bucuresti, Chimie (Romania)

Appl. Elec. Phenomena (Engl. Transl.)
Applied Electrical Phenomena (English Translation of Elektronnaya Obrabotka Materialov) (U.S.)

Appl. Solar Energy (USSR) (Engl. Transl.)
Applied Solar Energy (USSR) (English Translation of Geliotekhnika) (U.S.)

App. Metody Rentgenovskogo Anal.
Apparatura i Metody Rentgenovskogo Analiza (U.S.S.R.)

Araneta J. Agr.
Araneta Journal of Agriculture (Philippines)

Arch. Dermatol. Forsch.
Archiv fuer Dermatologische Forschung (West Germany)
Supersedes Arch. Klin. Exp. Dermatol.

Arch. Fund. Roux-Ocefa
Archivos de la Fundacion Roux-Ocefa (Argentina)

Arch. Julius Klaus-Stift. Vererbungsforsch., Sozialanthropol. Rassenhyg.
Archiv der Julius Klaus-Stiftung fuer Vererbungsforschung, Sozialanthropologie und Rassenhygiene (Switzerland)

Arch. Sci. Biol. (Bologna)
Archivio di Scienze Biologiche (Bologna) (Italy)

Arctic
Arctic (U.S. - Canada)

Ark. Mat., Astron. Fys.
Arkiv for Matematik, Astronomi och Fysik (Sweden)

Astronautyka
Astronautyka (Poland)

At. Jap.
Atoms in Japan (Japan)

Aufbereit.-Tech.
Aufbereitungs-Technik (West Germany)

Aufschluss
Aufschluss (West Germany)

Aust. Elec. World
Australian Electrical World, The (Australia)

Automatica
Automatica (England - U.S.)

Awamia
Awamia, Al (Morocco)

B

Ber. Geol. Ges. Deut. Demokrat. Repub. Gesamtgeb. Geol. Wiss.
Berichte der Geologischen Gesellschaft in der Deutschen Demokratischen Republik fuer das Gesamtgebiet der Geologischen Wissenschaft (East Germany)
Divided into Ber. Deut. Ges. Geol. Wiss., Reihe A and Ber. Deut. Ges. Geol. Wiss., Reihe B

Ber. Getreidechem.-Tag., Detmold
Bericht ueber die Getreidechemiker-Tagung, Detmold (West Germany)

Beton, Herstellung, Verwend.
Beton, Herstellung, Verwendung (West Germany)

Biol. Conserv.
Biological Conservation (England)

Biol. Neonate
Biology of the Neonate (Switzerland)
Supersedes Biol. Neonatorum

Bitki Koruma Bul.
Bitki Koruma Bulteni (Plant Protection Bulletin) (Turkey)

Bitumen, Teere, Asphalte, Peche
Bitumen, Teere, Asphalte, Peche und Verwandte Stoffe (West Germany)

Boll. Mal. Orecchio, Gola Naso
Bollettino delle Malattie dell'Orecchio, della Gola e del Naso (Italy)

Boll. Soc. Geol. Ital.
Bollettino della Societa Geologica Italiana (Italy)

Boll. Unione Mat. Ital.
Bollettino dell'Unione Matematica Italiana (Italy)

Boll. Unione Mat. Ital., Ser. IV
Bollettino delle Unione Matematica Italiana, Series IV (Italy)

Bot. Rev.
Botanical Review, THe (U.S.)

Brit. Chem. Eng. Process Technol.
British Chemical Engineering and Process Technology (England)
Supersedes British Chemical Engineering

Brit. Engine Tech. Rep.
British Engine Technical Reports (England)

Bull. Ass. Anciens Eleves Inst. Ind. Ferment. Bruxelles
Bulletin de l'Association des Anciens Eleves de l'Institut des Industries de Fermentation de Burxelles (Belgium)

Bull. Bot. Soc. Bengal
Bulletin of the Botanical Society of Bengal (India)

Bull. Doc., Cent. Inform. Chrome Dur
Bulletin de Documentation, Centre d'Information du Chrome Dur (France)

Bull. Grain Technol.
Bulletin of Grain Technology (India)

Bull. Inform. Generateurs Isotop.
Bulletin d'Information sur les Generateurs Isotopiques (France)
Issued in English version as Information Bulletin on Isotopic Generators

Bull. Sci., Cons. Acad. Sci. Arts RSF Yougoslavie, Sect. A
Bulletin Scientifique, Conseil des Academies des Sciences et des Arts de la RSF de Yougoslavie, Section A. Sciences Naturelles, Techniques et Medicales (Yugoslavia)

Byull. Inst. Astrofiz., Akad. Nauk Tadzh. SSR
Byulleten Instituta Astrofiziki, Akademiya Nauk Tadzhikskoi SSR (Tadzhik S.S.R.)

Byull. Nauch.-Tekh. Inform. Agron. Fiz.
Byulleten Nauchno-Tekhnicheskoi Informatsii po Agronomicheskoi Fizike (U.S.S.R.)

Byull. Tsentra Yadern. Dannym
Byulleten Tsentra po Yadernym Dannym (U.S.S.R.)

C

Can. Geogr.
Canadian Geographer (Canada)

Can. J. Pharm. Sci.
Canadian Journal of Pharmaceutical Sciences (Canada)

Can. J. Spectrosc.
Canadian Journal of Spectroscopy (Canada)
Supersedes Can. Spectrosc.

Cardiology
Cardiology (Switzerland)
Supersedes Cardiologia

Cell. Immunol.
Cellular Immunology (U.S.)

Cem. Concr. (Delhi)
Cement and Concrete (Delhi)

Chagyo Gijutsu Kenkyu
Chagyo Gijutsu Kenkyu (Study of Tea) (Japan)

Chem. Chron., Epistem. Ekdosis
Chemika Chronika, Epistemonike Ekdosis (Greece)

Chem. Stosow., Ser. B
Chemia Stosowana, Seria B. Kwartalnik Poswiecony Zagadnieniom Inzynierii i Aparatury Chemicznej (Poland)

Chem.-Ztg., Chem. App.
Chemiker-Zeitung, Chemische Apparatur (West Germany)
Supersedes Chemiker-Zeitung

Chislennye Metody Mekh. Sploshnoi Sredy
Chislennye Metody Mekhaniki Sploshnoi Sredy (U.S.S.R.)

Clin. Otorinolaringoiat.
Clinica Otorinolaringoiatrica (Italy)

Collect. Treatises Fac. Hum., Univ. Fukuoka
Collection of Treatises Published by Faculty of Humanity, University of Fukuoka (Japan)

Commentat. Biol.
Commentationes Biologicae, Societas Scientiarum Fennica (Finland)

Comments Plasma Phys. Controlled Fusion
Comments on Plasma Physics and Controlled Fusion (England)

Computing
Computing (Austria)

Confructa
Confructa (West Germany)

Contam. Contr.
Contamination Control (U.S.)

Cryog. Eng. (Tokyo)
Cryogenic Engineering (Tokyo) (Japan)

Curr. Top. Radiat. Res. Quart.
Current Topics in Radiation Research Quarterly (Netherlands)
Supersedes Curr. Top. Radiat. Res.

Cutting Tool Eng.
Cutting Tool Engineering (U.S.)

D

Dainichi Nippon Densen Jiho
Dainichi Nippon Densen Jiho (Dainichi-Nippon Cables Review) (Japan)

Delt. Hellen. Mikrobiol. Hyg. Hetair.
Deltion Hellenikes Mikrobiologikes kai Hygieinologikes Hetaireias (Greece)

Demag Nachr.
Demag Nachrichten (West Germany)

Denki Keisan
Denki Keisan (Electrical Calculaton) (Japan)

Denshi Gijutsu Sogo Kenkyusho Chosa Hokoku
Denshi Gijutsu Sogo Kenkyusho Chosa Hokoku (Japan)

Dermatol. Monatsschr.
Dermatologische Monatsschrift (East Germany)

Doboku Gijutsu Shiryo
Doboku Gijutsu Shiryo (Public Works Review) (Japan)

Draht
Draht (West Germany)

Draht-Welt
Draht-Welt (West Germany)

Drug Ther. Bull.
Drug and Therapeutics Bulletin (England)

E

Earth Sci. Bull.
Earth Science Bulletin (U.S.)

Ecology (USSR) (Engl. Transl.)
Ecology (USSR) (English Translation of Ekologiya) (U.S.)

Econ. Int. Fonti Energ.
Economia Internazionale delle Fonti di Energia (Italy)

Econ. Trentina
Economia Trentina (Italy)

Eisenbahn-Ing.
Eisenbahn-Ingenieur (West Germany)

Ekologiya
Ekologiya (U.S.S.R.)

Elec. News Eng.
Electrical News and Engineering (Canada)

Elektro-Anz.
Elektro-Anzeiger (West Germany)

Elektronik (Munich)
Elektronik (Munich) (West Germany)

Elektron.-Ztg.
Elektronik-Zeitung (West Germany)

Elelmiszervizsgalati Kozlem.
Elelmiszervizsgalati Kozlemenyek (Hungary)

Energ. Elek.
Energetika i Elektrifikatsiya (Ukrainian S.S.R.)

Energiewirt. Tagesfragen
Energiewirtschaftliche Tagesfragen (West Germany)

Energ. Stroit.
Energeticheskoe Stroitel'stvo (U.S.S.R.)

Eng. Cybern. (USSR) (Engl. Transl.)
Engineering Cybernetics (USSR) (English Translation of Izvestiya Akademii Nauk SSSR, Tekhnicheskaya Kibernetika) (U.S.)

Environ. Aff.
Environmental Affairs (U.S.)

Environ. Contr. Saf. Manage.
Environmental Control and Safety Management (U.S.)

Environ. Physiol.
Environmental Physiology (Denmark)

Enzyme
Enzyme (Switzerland)
Supersedes Enzymol. Biol. Clin.

EOS, Trans., Amer. Geophys. Union
EOS, Transactions, American Geophysical Union (U.S.)
Supersedes Trans. Amer. Geophys. Union

Eur. J. Clin. Pharm.
European Journal of Clinical Pharmacology Continues Pharmacol. Clin.

Europlast. Mon.
Europlastics Monthly (England)
Supersedes British Plastics

Eur. S. Observ., Bull.
European Southern Observatory, Bulletin (West Germany)

F

Farmacia (Bucharest)
Farmacia (Bucharest) (Romania)

Farm J. (Calcutta)
Farm Journal (Calcutta) (India)

Fertigung
Fertigung (Switzerland)

Festkoerperprobleme
Festkoerperprobleme (West Germany)

Fiz. Elem. Chastits At. Yadra
Fizika Elementarnykh Chastits i Atomnogo Yadra (U.S.S.R.)

Fiz. Szk.
Fizyka w Szkole (Poland)

Folia Forest. (Helsinki)
Folia Forestalia (Helsinki) (Finland)

G

Galvano
Galvano (France)

Gartenbauwissenschaft
Gartenbauwissenschaft (West Germany)

Geliotekhnika
Geliotekhnika (Uzbek S.S.R.)
Issued in English translation as Applied Solar Energy (USSR)

Geokhim. Sb.
Geokhimicheskii Sbornik (U.S.S.R.)

Geol. Tec.
Geologia Tecnica (Italy)

Gesuido Kyokai-Shi
Gesuido Kyokai-Shi (Journal of Japan Sewage Works Association) (Japan)

Gidromekhanika
Gidromekhanika (Ukrainian S.S.R.)

Glastech. Ber.
Glastechnische Berichte (West Germany)

God. Sofii. Univ., Biol. Fak.
Godishnik na Sofiiskiya Universitet, Biologicheski Fakultet (Bulgaria)

God. Sofii. Univ., Fiz. Fak.
Godishnik na Sofiiskiya Universitet, Fizicheski Fakultet (Bulgaria)

God. Zb. Med. Fak. Skopje
Godisen Zbornik na Medicinskiot Fakultet vo Skopje (Yugoslavia)

Gorskostop. Nauka
Gorskostopanska Nauka (Yugoslavia)

Gravitatsiya Teor. Otnositel'nosti
Gravitatsiya i Teoriya Otnositel'nosti (U.S.S.R.)

H

Haematol. Bluttransfus.
Haematologie und Bluttransfusion (Suppl. to Blut) (West Germany)

Han'guk Sikp'um Kwahakhoe Chi
Han'guk Sikp'um Kwahakhoe Chi (Journal of the Korean Society of Food Science and Technology) (South Korea)

Health Serv. Rep.
Health Services Reports (U.S.)
Supersedes HSMHA Health Rep.

Heat Transfer - Jap. Res.
Heat Transfer - Japanese Research (U.S.)

Heft Unfallheilk.
Heft zur Unfallheilkunde; Beiheft zur Monatsschrift fuer Unfallheilkunde, Versicherungs-, Versorgungs- und Verkehrsmedizin (West Germany)

Hiroshima Daigaku Genbaku Hoshano Igaku Kenkyusho Nenpo
Hiroshima Daigaku Genbaku Hoshano Igaku Kenkyusho Nenpo (Proceedings of the Research Institute for Nuclear Medicine and Biology, Hiroshima University) (Japan)

Hiroshima Nogyo Tanki Daigaku Kenkyu Hokoku
Hiroshima Nogyo Tanki Daigaku Kenkyu Hokoku (Bulletin of the Hiroshima Agricultural College) (Japan)

Hokkaido Daigaku Kogakubu Kenkyu Hokoku
Hokkaido Daigaku Kogakubu Kenkyu Hokoku (Bulletin of the Faculty of Engineering, Hokkaido University) (Japan)

HortScience
HortScience (U.S.)

Hoshasen Butsuri Kenkyu
Hoshasen Butsuri Kenkyu (Japan)

Hum. Pathol.
Human Pathology (U.S.)

I

Ind. At. Spatiales
Industries Atomiques et Spatiales (France)
Supersedes Ind. At. and Sci. Ind. Spatiales, beginning Jan. 1972

Ind.-Elek. Elektron.
Industrie-Elektrik und Elektronik (West Germany)

Indiana Univ. Math. J.
Indiana University Mathematics Journal (U.S.)
Supersedes J. Math. Mech.

Indian Eng.
Indian Engineer (India)

Indian Geotech. J.
Indian Geotechnical Journal (India)

Indian J. Anim. Sci.
Indian Journal of Animal Sciences (India)

Indian J. Biochem. Biophys.
Indian Journal of Biochemistry and Biophysics (India)
Continues Indian J. Biochem.

Indian J. Vet. Sci. Anim. Husb.
Indian Journal of Veterinary Science and Animal Husbandry (India)
Continued as Indian J. Anim. Sci.

Indian Mining Eng. J.
Indian Mining and Engineering Journal (India)

Ingegneria
Ingegneria (Italy)

Instrum. Power Ind.
Instrumentation in the Power Industry (U.S.)

Int. Comp. Law Quart.
International and Comparative Law Quarterly, The (England)

Int. J. Environ. Anal. Chem.
International Journal of Environmental Analytical Chemistry (England)

Int. J. Mech. Sci.
International Journal of Mechanical Sciences (England)

Int. Ver. Theor. Angew. Limnol., Mitt.
International Vereinigung fuer Theoretische und Angewandte Limnologie, Mitteilungen (West Germany)

Iwate Igaku Zasshi
Iwate Igaku Zasshi (Journal o the Iwate Medical Association) (Japan)

Izotoptechnika
Izotoptechnika (Hungary)
Supersedes Atomtech. Tajek.

Izv. Akad. Nauk Tadzh. SSR, Otd. Fiz.-Mat. Geol.-Khim. Nauk
Izvestiya Akademii Nauk Tadzhikskoi SSR, Otdelenie Fiziko-Matematicheskikh i Geologo-Khimicheskikh Nauk (Tadzhik S.S.R.)

Izv. Estestvennonauch. Inst. Perm. Gos. Univ.
Izvestiya Estestvennonauchnogo Instituta pri Permskom Gosudarstvennom Universitete (U.S.S.R.)

Izv. Leningrad. Elektrotekh. Inst.
Izvestiya Leningradskogo Elektrotekhnicheskogo Instituta (U.S.S.R.)

Izv. Vyssh. Ucheb. Zaved., Neft Gaz
Izvestiya Vysshikh Uchebnykh Zavedenii, Neft i Gaz (Azerbaidzhan S.S.R.)

J

J. Allergy Clin. Immunol.
Journal of Allergy and Clinical Immunology (U.S.)
Supersedes J. Allergy

J. Amer. Concr. Inst.
Journal of the American Concrete Institute (U.S.)

J. Chem. Soc., Chem. Commun.
Journal of the Chemical Society (London), Chemical Communications (England)
Supersedes J. Chem. Soc., D

J. Chem. Soc., Dalton Trans.
Journal of the Chemical Society (London), Dalton Transactions (England)
Supersedes in part J. Chem. Soc., A

J. Chem. Soc., Faraday Trans., I
Journal of the Chemical Society (London), Faraday Transactions, I (England)
Supersedes in part J. Chem. Soc., A and Trans. Faraday Soc.

J. Chem. Soc., Faraday Trans., II
Journal of the Chemical Society (London), Faraday Transactions, II (England)
Supersedes in part J. Chem. Soc., A and Trans. Faraday Soc.

J. Chem. Soc., Perkin Trans., II
Journal of the Chemical Society (London), Perkin Transactions, II (England)
Supersedes J. Chem. Soc., B

J. Chromatogr. Sci.
Journal of Chromatographic Science (U.S.)
Supersedes Journal of Gas Chromatography

J. Conn. State Dent. Ass.
Journal of the Connecticut State Dental Association (U.S.)

J. Coord. Chem.
Journal of Coordination Chemistry (England)

J. Eur. Toxicol.
Journal Europeen de Toxicologie (France)

J. Fla. Med. Ass.
Journal of the Florida Medical Association (U.S.)

J. Ga. Entomol. Soc.
Journal of the Georgia Entomological Society (U.S.)

J. Geol. Soc. India
Journal of the Geological Society of India (India)

Jinruigaku Zasshi
Jinruigaku Zasshi (The Journal of the Anthropological Society of Japan) (Japan)

J. Jap. Soc. Appl. Phys., Suppl.
Journal of the Japan Society of Applied Physics, Supplement (Japan)

J. Korean Inst. Electron. Eng.
Journal of the Korean Institute of Electronics Engineers, The (Jeonja-gonghakhoe-ji) (South Korea)

J. Microscopy
Journal of Microscopy (England)
Supersedes J. Roy. Microscop. Soc.

J. Non-Cryst. Solids
Journal of Non-Crystalline Solids (Netherlands)

Joekull (Reykjavik)
Joekull (Reykjavik) (Iceland)

J. Ont. Dent. Ass.
Journal of the Ontario Dental Association, The (Canada)

J. Paint Technol.
Journal of Paint Technology (U.S.)

J. Periodontal Res.
Journal of Periodontal Research (Denmark)

J. Phys. Chem. Ref. Data
Journal of Physical and Chemical Reference Data (U.S.)

J. Soc. Dyers Colour.
Journal of the Society of Dyers and Colourists (England)

J. Zool.
Journal of Zoology (England)

K

Kagaku Keizai
Kagaku Keizai (Chemical Industrial Economy) (Japan)

KFK Nachr.
KFK (Kernforschungszentrum Karlsruhe) Nachrichten (West Germany)

Kibern. Vychisl. Tekh.
Kibernetika i Vychislitel'naya Tekhnika (Ukrainian S.S.R.)

Kim. Sanayi
Kimya ve Sanayi (Turkey)

Koku Igaku Jikkentai Hokoku
Koku Igaku Jikkentai Hokoku (The Reports of the Aero Medical Lab.) (Japan)

Komety Meteory
Komety i Meteory (Tadzhik S.S.R.)

Konstr. Ing. Ber.
Konstruktiver Ingenieurbau Berichte (West Germany)

Konstr. Mater. Osn. Grafita
Konstruktsionnye Materialy na Osnove Grafita (U.S.S.R.)

Korean Biochem. J.
Korean Biochemical Journal, The (Hankuk Saenghwahakhoe-ji) (South Korea)

Korean J. Hort. Sci.
Korean Journal of Horticultural Science (Hankuk Wonyehakhow-ji) (South Korea)

Koryo
Koryo (Aromatics) (Japan)

Kotsu Igaku
Kotsu Igaku (The Journal of Transportation Medicine) (Japan)

KSB Tech. Ber.
KSB (Klein, Schanzlin, Becker) Technische Berichte (West Germany)

Kuki Chowa To Reito
Kuki Chowa To Reito (Air Conditioning and Refrigeration) (Japan)

Kvantovaya Elektron.
Kvantovaya Elektronika (Ukrainian S.S.R.)

L

Lesovedenie
Lesovedenie (U.S.S.R.)

Life Sci. Space Res.
Life Sciences and Space Research (Netherlands)

Log Anal.
Log Analyst (U.S.)

M

Magy. Allami Eotvos Lorand Geofiz. Int. Evi Jelentese
Magyar Allami Eotvos Lorand Geofizikai Intezet Evi Jelentese (Hungary)

Magy. Asvanyolaj Foldgaz Kiserl. Intez. Kiadv.
Magyar Asvanyolaj es Foldgaz Kiserleti Intezet Kiadvanyai (Hungary)

Magy. Textiltech.
Magyar Textiltechnika (Hungary)

Magy. Tud. Akad. Biol. Tud. Oszt. Kozlem.
Magyar Tudomanyos Akademia Biologiai Tudomanyok Osztalyanak Kozlemenyei (Hungary)

Maintenance
Maintenance (France)

Mannesmann Forschungsber.
Mannesmann Forschungsberichte (West Germany)

Mashinostroene
Mashinostroene (Bulgaria)

Mater. Tech.
Materiaux et Techniques (France)

Medd. Nor. Skogforsoeksv.
Meddelelser fra det Norske Skogforsoeksvesen (Norway)

Med. Lab. Technol.
Medical Laboratory Technology (England)
Supersedes J. Med. Lab. Technol.

Med. Microbiol. Immunol.
Medical Microbiology and Immunology (West Germany)
Supersedes Z. Med. Mikrobiol. Immunol.

Mem. Accad. Sci. Torino, Cl. Sci. Fis., Mat. Natur.
Memoire della Accademia delle Scienze di Torino, Classe di Scienze Fisiche, Matematiche e Naturali (Italy)

Mem. Real Acad. Cienc. Artes Barcelona
Memorias de la Real Academia de Ciencias y Artes de Barcelona (Spain)

Metallges., Rev. Activ.
Metallgesellschaft, Review of the Activities (West Germany)
German Edition issued as Metallges., Mitt. Arbeitsbereich

Metallofizika
Metallofizika (Ukrainian S.S.R.)

Metall-Reinig. Vorbehandl.
Metall-Reinigung und Vorbehandlung (West Germany)

Metallurgie (Mons, Belg.)
Metallurgie (Mons, Belgium) (Belgium)

Metalwork. Econ.
Metalworking Economics (U.S.)

Methods Biochem. Anal.
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Moessbauer Effect Methodology, Proceedings of a Symposium (U.S.)

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Morskie Gidrofizicheskie Issledovaniya (U.S.S.R.)

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Munca Sanitara (Romania)

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National Bureau of Standards (U.S.), Special Publication (U.S.)

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Natura (Plovdiv) (Bulgaria)

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